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ABSTRACT

The findings are presented of a study designed to identify and examine factors and variables related to mathematics learning among blacks, both those with a quantitative orientation and those without such an orientation. Four sample populations were studied: junior high school students, senior high school students, college students, and adult professionals. This report considers: (1) project activities; (2) sampling; (3) data collection; (4) research instrumentation; (5) coding and computer programming; (6) the analysis of the adult professional sample in terms of sample characteristics; family background; extracurricular activities; academic factors; persons influencing selection of high school mathematical courses; math-related activities; self-assessment of math abilities; attitudes toward math class and math teachers; favorite and least favorite subjects; factors and persons influential in selecting occupations, college majors and math courses; math and society; and personal and psychological variables; and (7) model building. Recommendations are offered in three areas where additional effort is required to overcome the larger problem of black underrepresentation in scientific and technical occupations: (1) black family and community life; (2) school and curricular issues; and (3) personal factors. Attachments to the report present data analyzed from the high school and the junior high school sample populations and are entitled: "The Quantitative Orientation of Black High School Students" (Donna Jean Blackwell, 1983 doctoral dissertation) and "Psychosocial Influences on the Math Attitudes and Interests of Black Junior High School Students" (Robert C. Johnson, 1981). A bibliography is also appended: "A Partial Bibliography on Blacks in Science, Technology, and Related Areas" (Robert C. Johnson, Comp., 1980). (RDN)

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FINAL REPORT

PSYCHOSOCIAL FACTORS AFFECTING THE MATHEMATICAL ORIENTATION OF BLACK AMERICANS

U.S. DEPARTMENT OF EDUCATION
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TABLE OF CONTENTS

SECTION PAGE

I. PURPOSE OF STUDY 1

II. PROJECT ACTIVITIES 2

III. SAMPLING 7

- Adult-Professionals 7
- College Students 8
- High School and Junior High School Students 11
- Experimental Treatments 15

IV. DATA COLLECTION 18

V. INSTRUMENTATION 22

VI. CODING AND COMPUTER PROGRAMMING 25

VII. ANALYSIS OF ADULT PROFESSIONAL SAMPLE 27

- Conceptual and Operational Definitions 27
- Sample Characteristics 28
- Family Background 30
- Extracurricular Activities 32
- Academic Factors: Math Classes and Math Activities 33
- Persons Influencing Selection of High School Math Courses 35
- Math-Related Activities 35
- Self-Assessment of Math Abilities 36
- Attitudes toward Math Classes and Math Teachers 37

Favorite and Least Favorite Subjects 38

Factors and Persons Influential in Selecting Occupations, College Majors and Math Courses 39

Math and Society 42

Personal and Psychological Variables 44

VIII. MODEL BUILDING 47

IX. CONCLUSIONS AND RECOMMENDATIONS 52

Conclusions 52

Recommendations 63

REFERENCES 70

TABLES 71

I. Purpose of Study

This report presents the findings of a study designed to identify and examine factors and variables related to mathematics learning among Black Americans. Interview and survey research methods yielded data on personal, family, and social variables from samples of Black youths and adults in the St. Louis metropolitan area. Four such samples were drawn from the following subpopulations: junior high school students; senior high school students; college students; and adult professionals. Each sample consisted of both Blacks with a "quantitative orientation" and those without. This study attempts to identify distinguishing factors between the quantitative and non-quantitative persons in the samples.

Because of financial and time limitations the principal analysis in this report focuses on the adult professional sample. Data from two of the other three samples have been analyzed and these reports (in the form of a doctoral dissertation, Blackwell, 1983, and an unpublished paper, Johnson, 1981) are attached to this final report. The dissertation examines the high school data, and the paper reports findings from the junior high school sample. The college student data will be analyzed at a future time.

II. Project Activities

The Black Mathematical Orientation Project (BMOP) entailed several operations and stages: establishing operations; sampling; instrument development; data collection; coding and computer programming; and data analysis. In the course of the project a bibliography was compiled. These various activities are briefly reported on below.

Operations and Personnel. While this project operated from an organization with a good deal of experience in research management, and while it had the principal investigator and project coordinator on board from the beginning, it did experience some difficulties which affected its time line.

The original proposal for this project called for a beginning date of July 1, 1979 for the initiation of the project activities. It was not until July of 1979 that the Institute of Black Studies was notified that the proposal entitled, Psycho-Social Factors Affecting the Mathematical Orientation of Black Americans, had been awarded funds by the National Institute of Education. Following negotiations between staff members of the National Institute of Education and officials of the Institute of Black Studies, the starting date for this project was set at September 1, 1979.

Also, it should be noted that from the time of the initial notification of the award the staff spent an inordinate amount of person-hours attempting to straighten out an administrative error made at the National Institute of Education concerning the system of payment for the project. During the time of the negotiations, the Institute of Black Studies had requested that payment be made through the Department of Health Education and Welfare's Departmental Federal Assistance Financing system (DFAF). However, although all of the appropriate information was given, an over-sight occured which required a considerable amount of effort and expense to track down and to try to rectify; this award was not placed in the DFAF system. No payment was received until mid-December (1979) when the Institute was finally reimbursed through special payment procedures. This error hampered our progress by requiring us to concentrate a great deal of time and effort on this matter.

Another administrative problem at the NIE offices created further difficulties for the project after its first year. A serious problem with funding occurred during the fifth quarter. The Federal Assistance Finance Branch did not receive notice of the continuation award for this project, and therefore would not honor our request for funds after September 1, 1980. This difficulty was not resolved (i.e. funds being sent) until December, 1980. This matter created a number of problems since several activities had to be suspended or curtailed untl it was clear that funds would be available. There was even the problem of meeting the project staff's payroll on several occasions during this period. The resolution of this problem required a considerable amount of time and effort on the part of the staff, and an inordinate amount of money on the part of the sponsoring agency (the Institute of Black Studies).

Another area that posed problems for this project was personnel, in particular the retention of a project secretary. In its first 5 quarters of operations, the project had three secretaries. Since it was difficult to attract qualified candidates because of the relatively low salary and part-time nature of the position, it was decided not to fill the position because a great deal of time, energy and resources went into recruiting, training and supervising the person working in this capacity. Also since the project was close to its termination date as far as funding was concerned, the short duration of the existence of the position would also have added to the difficulty of recruiting someone for this position. Instead, we decided to utilize part-time secretarial and clerical help for the duration of this project. This arrangement was manageable because the bulk of the typing had been associated with the development of the instruments and correspondence with the respondents.

For a variety of reasons, many of the persons originally hired as interviewers were not able to remain with the project because: (1) The temporary and part-time nature of the job and the demands of other obligations did not allow some of the interviewers to complete all of their assignments; (2) There were some difficulties with the original junior high school sample that discouraged some of the interviewers; and (3) The period of interviewing and data collection was extended unexpectedly beyond the original date which meant that many of the original interviewers changed their status, moved away or became involved in other activities. Nonetheless, there remained a core of highly trained and experienced interviewers who worked with the various samples, and did the bulk of the interviewing.

Of the many interviewers used in this project, only one caused a problem by turning in some falsified interviews (14) toward the end of the data collection period. These faked data were spread among the four samples. This problem required the expanditure of additional time and money to interview additional persons.

While the project had to struggle with administrative and personnel problems, it received strong support from the sponsoring agency, the Institute of Black Studies, and had a nucleus of committed staff persons which permitted it to function despite the above-noted problems.

The Institute of Black Studies showed its commitment to the project by advancing funds to it when we were experiencing difficulties with the funding source. Furthermore, the Institute of Black Studies underwrote the cost of continuing the project after funds from NIE were spent. The Board of Directors also assisted in fundraising efforts aimed at outside funding sources.

Ms. Donna Blackwell Taylor, who served as project director, resigned late in project in order to seek a higher-paying job. Nonetheless, she remained involved with the project on a volunteer basis throughout its duration. Her doctoral dissertation presents an analysis of the high school sample.

This project also had the good fortune of having research assistants and work-study students who worked conscientiously doing the very unpleasant tasks associated with research work. Some of these persons also worked on a volunteer basis after the funding for the project had run out.

A small grant from Anheuser-Busch, Inc. permitted work on this project to continue during the summer of 1982.

III. Sampling

Different sampling procedures were used to generate each of the four samples.

Adult-Professionals: A list of local Black professionals employed in math-related disciplines was obtained and compiled by corresponding with local math and science organizations, colleges and school districts. Individuals known personally by staff members were also identified. These persons in turn were asked to identify colleagues in their fields. Individuals were randomly selected from this list and asked to participate in the study. Additionally, a siriliar list of professional Black persons not employed in quantitative-based fields was compiled and sampled.

Organizations and institutions contacted to draw the quantitative and non-quantitative professional samples included:

(1) National Organization for the Professional Advancement of Black Chemists and Chemical Engineers

(2) American Association of Blacks in Energy

(3) Association of Black Engineers and Applied Scientists

(4) National Association of Mathematicians

(5) National Pharmaceutical Association

(6) Society of Black Physicists

(7) National Institute of Science

(8) Organization of Black Scientists, Inc.

(9) National Technical Association, Inc.

(10) Association of Non-white Concerns of the American Personnel and Guidance Association

(11) Association of Black Social Workers

(12) National Association of Black Accountants

(13) St. Louis Association of Black Psychologist

(14) Mound City Bar Association (Local Black Lawyer Association)

(15) National Organization of Minority Architects

As a rule, persons in this sample responded in a very cooperative manner. A detailed examination of the make-up of the adult professional sample is provided in Section VII below.

College Students: College juniors and seniors were selected for inclusion in this study because by the junior and senior years, students will have decided upon a college major, and will have taken the necessary courses toward completion that major.

The college juniors and seniors were to be selected from four local colleges and universities. Our goal was to find third and fourth year students in both quantitative and non-quantitative majors and invite them to participate in the study. In order to identify and subsequently contact these students two methods were employed. First of all, verbal presentations and written project summaries were given to key university/ college personnel. Without exception the names and addresses of students were provided by these persons. Some of these lists also identified the major of the students.

In order to further refine the college student lists (that is, identify persons specifically in the quantitative majors) the project staff contacted student organizations such as the Society of Black Engineering Students, and the Black Pre-Medical Association at one institution. Presentations were made to the entire membership and/or to the organization's leaders. In addition, programs designed to increase the numbers of Blacks in quantitative professions were identified; as with the student organizations verbal presentations were made. At other universities, faculty and staff persons identified students majoring in a math-related field or mathematics. The college/university recruitment effort yielded a pool of approximately two hundred persons. Students were randomly selected from the compiled lists of quantitative and non-quantitative majors and contacted about participation in this study.

Because of the several delays due to personnel and other reasons as described above, it was not possible to begin data collection on the college sample as anticipated. Consequently, when the interviewing of this group began in late April-early May 1980, many of the students in the collge group were in the process of taking exams, preparing for graduation, or preparing to leave the city. Thus, we were either unable to reach many of them or could not gain their cooperation to participate in this study. As a result only about half (twenty six) of this sample had been interviewed up to that time. The revised strategy was to continue the interviews of college students in the following September (1980) when school resumed.

Since this group is not being analyzed a description of the sample is provided here. A total of forty-nine students were interviewed (one less than the goal of 50). Approximately 84% of the students came from the two major universities in the area (Washington (59%) and St. Louis (25%) universities). Five students were matriculated at Webster University (then Webster College), and the other three from other schools. There are 24 females and 25 males in the sample. Over three-fourths of the sample (38) have never been married, nine were married and two were divorced at the time of the interview.

Most of the students were from the St. Louis area (61%), but ten states and one foreign country were represented by the sample.

About 96% of the students had identified a major, with 53% of these students majoring in math-related disciplines (natural and physical sciences, computer science, engineering, etc.).

In terms of family background, over half the students came from families with incomes under $20,000 (57.1%) and the others from families earning more than $20,000. Students majoring in scientific, technical, and math-related subjects were more likely to have families with high incomes (61.1%) than those in non-quantitative fields (54.2%). However, the difference is not statistically significant (using the chi-square test, p <.05). Similiarly, students in quantitative fields are more likely to have a father or male guardian in a professional or technical occupation than are the non-quantitative students. Again, this difference is not statistically significant.

In terms of gender, as noted above, the sample consisted of 24 females and 25 males. Twelve of the females and ten males identified non-quantitative disciplines as their majors, and eleven females and fourteen males were majoring in math-related areas. One of each sex did not have a declared major at the time of the interview.

The vast majority of the students were from urban areas (75.5%), and the rest were mainly from surburban communities (12.2%). Only 3 persons were from rural and small-town backgrounds. Three persons did not report the type of area in which they grew up. While quantitative students were more likely to report being from urban and suburban areas, the difference is not statistically significant. There are no significant regional differences between the two types of majors.

As noted above, time and financial constraints prevent the detailed study of this sample for this report, but it will be analyzed in future papers.

High School and Junior High School Students: In the original proposal it was anticipated that fifty 8th and 9th graders and fifty 12th graders would be included in the junior high and high school samples, respectively. However, some difficulties were incurred in obtaining these samples.

In order to get a reasonably representative sample of Black junior high and senior high school students, two metropolitan area school districts were designated. In both cases the respective superintendents of schools were contacted by the principal investigator and the project director. A verbal and written summary of the project's major goals, objectives and procedures was given to both persons. In both cases the response toward the aims of the project was very favorable, but neither district felt legally or ethically free to provide the project staff access to student records so that the appropriate students could be identified and contacted.

When we were informed that we could not use student records to identify prospective respondents, a new recruitment strategy was designed. This strategy incorporated the school districts as "middlemen"; essentially, school district personnel would conduct the recruitment mailing on behalf of the project. Unfortunately, this plan was flatly rejected by one district and not enthusiastically received by the other. Once more a recruitment strategy was proposed; this time it was accepted by both districts.

The third recruitment strategy consisted of having the project staff make presentations to the entire student body of the target junior and senior high schools during their assembly sessions. These presentations took place during the months of February and March. In one school district the presentation was woven into a lecture on Black history and was held during Black History week. In the other school district a brief presentation about the project was made, providing general informaton without going into detail about the study. In both cases a short letter was distributed to each student. This letter summarized the project and invited student participation. As a result of these efforts four hundred interested students were identified.

As it turned out, one school district was dropped from consideration because it was beset by a number of problems:

1. Student strikes and walk-outs;
2. Teacher's strike and walk-outs;
3. Conflicts between parents and the school board, and between the school board and teachers; and
4. The lost of accreditation by the state.

Because of these many problems, it was decided not to include the students from this district in the samples of high school and junior high school students. Not including these students did not represent a great lost of subjects because these students would have been a minor proportion of these samples. Furthermore, the meaningfulness of some other data would have been questionable since the students would have effectively lost a half semester of school due to the problems enumerated above.

Additional difficulties were encountered in the interviewing of the senior and junior high school students as there was an extremely high rate of refusals, of respondents who could not be reached, or who, at the last minute, changed their minds about participating in the project. However, during this period it was possible to complete the high school sample by including students from another local school district.

Although a great deal of effort was expended on getting sufficient numbers of junior high school students to participate and to have their parents consent and agree to be interviewed as well, this group and their parents were very suspicious and were extremely reluctant to be involved in this study. Consequently, after completing only 18 interviews it was decided to stop the interviewing with this group and to continue with the other sub-samples of this study, namely, the remainder of the college students and the adult professionals.

Given the difficulty of the interview method with the junior high school sample, a new approach in collecting data from junior high school students was employed. Several middle schools in the city of St. Louis were contacted about participation in the study. A total of six (6) classes representing two different schools were involved. Four eighth grade classes and two seventh grade classes constitute the sample for this group.

Based on a pilot study done as a class project by a student in one of the classes of the principal investigator at Washington University, a quasiexperimental study was designed for this group. A brief outline of this design is discussed. All of the classes were randomly assigned as whole units to the experimental treatment groups. Pre-test and post-test measures were administered to each of the classes. The pre-test measures contained information on a number of control variables as well as the dependent variables of attitudes towards mathematics, attitudes towards science, and career aspirations. The post-test measures contained items measuring the three dependent variables.

In addition to these instruments, the math and science teachers of these students were asked to provide an evaluation of each student in each of these two disciplines. Generally the sessions took place in either the students' social studies or English classes. The control variables for this study were: grade level, age, parents' socio-economic status, teachers' evaluation of students in math and science, students' interest in math and science activities, and the student's sex.

Experimental Treatments: The experimental treatments consisted of presentations, lectures and discussions, along with audio-visual materials and exhibits. The classes designated as experimental received information on the following topics: 1) The African and Afro-American heritage in science and technology; 2) The role and impact of science and technology in everyday life; 3) Career opportunities in science and technology; and 4) The educational preparation needed to participate in careers in science and technology. For the control group information was not provided about the historical and contemporary roles that Black Americans have played in the fields of science and technology. Instead, this group received information on the Civil Rights Movement and the general socio-economic opportunities that it spawned for Black Americans, followed by a discussion of items 2, 3 and 4 listed above for the experimental group.

The experimental group saw slides emphasizing the use of science and technology in Africa and heard a presentation on specific contributions that Black Americans have made to the advancement of science and technology in this country. In addition, these classes had a chance to peruse literature that showed the contributions of Black Americans in these areas, as well as information that explicitly had pictures and articles on contemporary careers in science and technology for Black Americans. On the other hand, the control group was exposed to an exhibition of articles and pictures showing Blacks in scientific and technical positions. The essential difference between these two treatments is that there was no explicit discussion of Black contributions to science and technology with the control classes.

Therefore, the experimental treatments were similiar in that both addressed the issue of science and technology in everyday life and the types of careers available in these fields, as well as the educational preparation needed to become engaged in them. In the experimental group the classes were given specific information about the roles, both historical and contemporary, that Black Americans and Africans have played in the development of science and technology. Both groups responded well to the presentations and discussions.

This study had the purposes of ascertaining 1)the types of career aspirations the students have and the correlates of these aspirations (i.e. age, socio-economic status, sex, previous participation in math and science activities, etc.) 2) the effects of providing information on the cultural heritage of Black Americans in the areas of science and technology on the science and math attitudes and career aspirations of young Black students, and 3) the interrelationship among attitudes towards math and science and career aspirations in this sample of junior high school students.

Some results from this study are presented in the paper attached as an appendix to this report.

IV. Data Collection.

Information was obtained from the various samples in basically three ways: For the adult-professional, college, and high school samples, self-administered, paper-and-pencil instruments and a structured interview schedule were used. A quasi-experimental research model was employed with the junior high school sample. Eightteen junior high school students were administered the interview schedule and the self-administered instruments, but because of the difficulty in recruiting adequate numbers in this age group, this approach was abandonned with this sample.

Prior to the interview session all respondents were contacted by phone and mail by the project staff and given information about the project. Interviewers of the same race, but not necessarily of the same sex, also called each respondent to arrange an interview appointment at a place convenient to the respondent.

At the time of the interview the interviewer explained the respondent's rights and the nature of the interview, and the respondents were asked to read and sign a consent form that explained the purpose of the study (in a general way), the potential benefits and risks, and the interviewee's rights. These forms were signed by both the respondent and the interviewer. (For minors, parents completed and signed the consent forms; parents and children were told of the safeguard and risks of the research.)

Respondents were then asked to complete the self-administered scales, after which the interviewer administered the structured interview schedule. Upon completion of this schedule the interviewer terminated the session.

Interviewers were instructed to complete an "Interviewer's Remarks" form immediately after the interview and return it with the other materials. This form ascertained the length of the interviews, the respondent's interest, cooperation, and understanding, and the presence of other persons during the session.

Follow-up phone calls and/or mailings were made to the adult sample several months after the interviews to obtain a piece of information that had been omitted from the interview schedule - the name, place, and racial composition of their undergraduate institutions.

The time periods for the data collection for the samples are given below:

Adult-Professional: Winter-Spring 1980-81.
College Students: Late Spring, Fall 1980.
High School Students: Spring, Summer 1980.
Junior High School Students:
- Interview Method - Spring, 1980
- Experimental Method - Winter, 1980-81.

The interviewers employed in this study were part-time persons, many of whom had previous experience in interview work (either in a research setting or social work context). Some had worked on previous research projects at the

Institute of Black Studies. Most were working professionals or graduate students. Some were upper-level undergraduate students.

The majority of the interviewers were trained in an all-day session. Their training consisted of an overview of the research project, a review of the role and responsibilities of the interviewer, as well as presentation of the procedures for contacting and interviewing respondents. This session also included review of and trial runs with all research instruments. Part of the training entailed showing them how to present to the respondents or the parents of the respondents the Research Safeguard Statement, and, for the minor students in the sample, permission sheets from the students and their parents to participate in the study.

Initially each interviewer was given the names and telephone numbers of five persons. In the event that prospective participants refused to participate or were impossible to locate (e.g. telephone disconnected) the interviewers were given new names and telephone numbers.

If interviewers were unable to arrange meetings with any of the persons assigned to them, or did not conduct satisfactory interviews they were terminated and their respondents were re-assigned to other interviewers.

As new interviewers were hired, they were given individual instructions on how to handle the materials. They were asked to complete pilot interviews before being hired. If their work was satisfactory, they were then assigned respondents to interview.

With all the safeguards built in to prevent the forging of data, one interviewer after turning in good work, began to falsify interviews and turned them in. This person was discovered when the data were being verified and edited. After the discovery we checked all of the interviews that he had completed and turned in, which included all four samples, and ascertained that fourteen of the interviews were forged. The person promised to re-conduct the interviews but never did.

V. Instrumentation

The research instruments used in this study were either: 1) selected from the literature and modified, if necessary; 2) adapted from previous related research; or 3) constructed *de novo*.

For each sample the instruments were developed to reflect the uniqueness of that group while maintaining a common set of variables that would allow cross-group comparisons. For example, similiar demographic, attitudinal, and math-activity questions are asked of all respondents regardless of sample. But items related to professional use of mathematics are inapplicable to all but the adult-professional sample. Likewise, some questions asked of junior high school students are not appropriate for the other samples.

The self-administered scales measuring 1) racial awareness; 2) values, and 3) religiosity were adapted from existing instruments with minor changes.

Demographic and family background items in the structured interview schedule were patterned after questions used in a Black family research project by this investigator (Johnson, 1980). These items in turn were adapted from other research studies on Black families, or developed according to accepted psychometric procedures. Items measuring attitudes towards mathematics, asking about math-re lated activities and the like, were generally adapted from previous studies (national and local) using these items. A number of items had to be developed specifically for this study, and were constructed according to standard psychometric practice.

Following the development of the instruments, two consultants with extensive backgrounds in math education and research reviewed and commented upon them. Following this review revisions were made as necessary, and the instruments piloted on small samples of the same types as the targeted population. Some changes resulted from these pilot studies. In the course of the actual administration of the instruments, minor revisions were made (the deletion of a few repetitive items).

As noted elsewhere, the most extensive set of data was collected on the adult-professional sample. For purposes of data reduction and analysis, several scales were created. Reliability data for these and other scales are reported below.

Scale	Instrument/Items	Reliability Coefficients (Alpha)
1. Present Math Activities	Interview Schedule/ Items 40-47	.835
2. College Math Activities	Interview Schedule/ Items 87-95	.851
3. High School Math Activities	Interview Schedule/ Items 120-128	.850
4. Junior High School Math Activities	Interview Schedule/ Items 151-159	.872
5. Perception of College Math	Interview Schedule/ Items 84a-84c	.811

Teacher		
6. Perception of High School Math Teacher	Interview Schedule/ Items 119a-119c	.781
7. Perception of Junior High School Math Teacher	Interview Schedule/ Items 161a-161c	.907
8. Black Communalism	Black Attitude Scale/ Items 2-10, 16, 17	.842
9. Black Identity	Black Attitude Scale/ Items 1, 18-20	.770
10. Interracialism	Black Attitude Scale/ Items 11-15	.266
11. Social Orientation	Values Activity Survey, Part I/Items 1-10, 41-50	.758
12. Theoretical Orientation	Values Activity Survey, Part I/Items 11-20, 51-60	.754
13. Economic-Political Orientation	Values Activity Survey, Part I/Items 31-40, 71-80	.843
14. Aesthetic Orientation	Values Activity Survey, Part I/Items 21-30, 61-70	.804
15. Religious Values	Values Activities Scale, Part II/Items 1-14	.443
16. Math and Society	Interview Schedule/ Items 49-52	.564
17. Math Self-Assessment	Interview Schedule/ Items 80c, 118, 150	.876

II. Coding and Computer Programming

A major task of this project was developing a coding scheme for the large number of open-ended items contained in the interview instruments. The responses to all of these items were listed and categories developed to encompass the responses. These categories were revised several times as problem responses arose, after editing the data, or after performing preliminary frequency counts. After much work, it was possible to standardize some types of categories across items and, in some cases, across samples (e.g., sports, hobbies, favorite and least favorite subjects). For a few items completely satisfactory categories were difficult to obtain (for example, responses to a question like: Why do you think mathematics is (more, as, less) important than (as) other subjects in everyday life?). Trying to code 35 to 50 different responses into 6 or 7 unique categories can prove to be quite challenging.

This process was repeated for each sample. Likewise, a computer program for each sample had to be written, using the Statistical Package for the Social Sciences. In the raw data form, several hundred variables were collected on each sample. For example, over seven hundred variables were in the adult professional data set. Writing and debugging the programs to permit data reduction and analysis required a great deal of time and effort. Again, this task had to be performed for each sample since there were variations in the research instruments used with each.

Editing the data also demanded great effort given the large number of variables for each sample. For the subsequent analyses to be valid, it was imperative to have "clean" data. Thus, the months spent cleaning up the data are justified.

Bibliography. In developing the proposal for this project and in the course of carrying out the project activities a number of references to Blacks in science, technology, and mathematics were encountered. Since there is a dearth of such information readily available, these references were organized and compiled as a partial bibliography.

Initial response to this work has been good. However, more recent works have appeared and some older works were not included, so an update would enhance the usefulness of this bibliography.

VII. Analysis of the Adult-Professional Sample

Conceptual and Operational Definitions: Mathematics orientation entails the predisposition to master and utilize mathematical concepts and skills in academic and professional settings. It is assumed that mathematical learning is manifested in the mastery and utilization of quantitative and computational skills and notions. Given the scope of this study a more direct definition and measure of mathematical learning cannot be devised.

Operationally, mathematical orientation was measured by severel related variables. These are (1) attitude toward and interest in mathematics as a subject; (2) one's mathematical self-concept, i.e., how the respondent evaluates him/herself in terms of quantitative ability; (3) grades in math classes; (4) number of math courses taken; and (5) college major in a math-based or related discipline. Self-reported information on junior high, high school and college math activity and performance was the sources of these data.

For purposes of analysis the empirical definition of math orientation will be limited to the selection of math-related college majors or professions. More specifically, those persons engaged in a current occupation which required courses in math (i.e. engineering, computer science) or majors that called for college-level math courses (e.g. pre-medicine) are considered to be "math-oriented". As to be expected, a strong association was found between the college majors and the occupations of the respondents. Those persons in the quantitative group generally consisted of engineers, scientific and technical persons, doctors, and math and science teachers. On the other hand, those persons in the non math-oriented group included accountants, social service professionals, non-math or -science teachers, persons in the legal professions, psychologists, counselors, and educational administrators. There are some "crossovers". These include several persons with degrees in science areas now working in non-technical professions. For example, there is one person with a PhD in chemistry who is now working as a college administrator. (See Table 1.)

Respondents in both groups indicated that they used mathematical operations in performing their job responsibilities. However, the two groups did differ in the types of mathematical operations used. The non-quantitative group generally indicated the use of the basic operations (addition and subtraction) and statistical analysis. The quantitative group indicated that they used the metric system, algebra, geometry and advanced mathematical techniques in their work. As Table 2 shows there is a great deal of congruency between the occupations of the respondents and the classifications in which they were placed.

Sample Characteristics: The adult-professional sample of 53 respondents was almost evenly divided between math-

and non math-oriented persons, 26 to 27 or 49.1% and 50.9%, respectively. Males outnumbered females 33 to 20 (64.2% vs. 35.8%). Married persons were the most numerous group (60.4%), followed by single persons (22.6%), the divorced (13.2%), and the separated (3.8%). Most respondents reported having children (56.6%). The average (mean) age of the sample at the time of the intervier was 35.2 years. The non math-oriented group was on the average five years older than their quantitative counterparts (mean ages: 37.6 and 32.9 years; sd = 10.3 and 9.2,for the non math-oriented and math-oriented groups, respectively).

They were as equally likely to live in the city of St. Louis as they were in the county, (45.3% to 47.2%), with 4 persons (7.5%) living outside of the area or not reporting their residency. The vast majority were homeowners (73.6%). The median income category for this sample was $31,000-$35,999. Total family incomes ranged from $13,000 to over $50,000.

Almost 60% of the respondents were born or raised in the St. Louis area. The others came primarily from southern communities or other midwestern states. The vast majority grew up in urban areas (81.1%), and the other respondents were from either small towns or rural areas (7.5% each). One person was from a suburban community and another did not report his or her area of upbring. Most reported growing up in predominately Black communities (81.1%), followed by racially mixed (9.4%) and predominately white (3.8%)

communities. Three persons gave no response to this item.

Family Background: Generally, no significant differences emerged in the family background of the two groups. However, it appears that the math-oriented group came from a slightly more favorable family background. Several measures were used to assess family demographics: these included a question determining whether parents owned or rented their homes, father's occupation, father's education, mother's occupation, and mother's education.

By these measures, the respondents from both groups came from families that appeared to be atypical of Black families in general. For the most part, their parents seemed to be middle-class In terms of homeownership, 83% of the math-oriented group reported that its family owned their own home compared to 66.7% of the non-math-oriented groups. Overall, 42% of the respondents indicated that their fathers were in professional, technical, managerial, or administrative occupations, (48% for the math-oriented and 36% for the non math-oriented). Likewise, the respondents reported a high level of college attendance for their fathers, with 48% of the math-oriented respondents indicating that their fathers went to college compared to 33% for the non-math-oriented. Twenty-five percent of the respondents indicated that their fathers had attended professional or graduate school as well (22.7% for the math-oriented and 27.3% of the non math-oriented).

Most of the respondents indicated that their mothers worked during their teenage years, 52% for the math-oriented and 77% for the non math-oriented. As with the fathers, a large percentage of the mothers were employed in professional, managerial, or technical fields (43%). On the average, the mothers of the respondents had completed high school and many of the respondents indicated that their mothers had attended college (50%). Almost 64% of the math-oriented respondents indicated that their mothers had a college education compared to 39% for the non math- oriented group. Approximately 17% of both groups indicated that their mothers attended graduate school.

While these findings on family characteristics are not statistically significant, they do indicate that math-oriented respondents tend to come from more favorable family backgrounds as measured by educational and occupational indicators than do non math-oriented respondents. However, both groups have a significantly higher percentage of families of middle-class status than do the Black population in general for the period when these respondents were growing up.

As for household composition, respondents in both groups lived, for the most part, in two-parent families. As Table 3 indicates, two-thirds of the math-oriented group grew up in two-parent households and 60% of the non math-oriented group. A larger percentage of the non math-oriented group had fathers absent from their households as they grew up. On the other hand, a larger percentage of the math-oriented group lived with neither parent as they grew up.

When we examine the geographical background of the parents we find, as Table 4 indicates, that the respondents' parents came from either urban or rural areas, followed by small towns. Very few of the parents were from suburban areas.

According to the respondents, their parents generally held high educational aspirations for them. As Table 5 shows, the parents of the math-oriented group were more likely to hope that their children would acquire at least a collegiate education.

The data in Table 6 indicate that parents of both groups assisted with the respondents' education. In the case of the fathers, when we control for father absence, we see that just as many fathers contributed to the respondents' education as did their mothers.

Math-oriented respondents were more likely to have lived in interracial neighborhoods or have attended predominately white schools then non math-oriented respondents. However, in both cases the majority of the respondents came from either predominately Black communities or attended predominately Black schools. Information on the racial composition of the respondents' neighborhoods and educational institutions is presented in Table 7.

Extra-Curricular Activities: In examining the kinds of activities that the participants engaged in during their collegiate, high school, and junior high years, it becomes evident that the vast majority of the respondents were active in some type of activity involving hobbies, sports, organizations, or volunteer work. For the most part, as the data in Table 8 show, there is little difference in the extent of participation.

The extent of the work experience was quite similar for both groups from junior high school to college, but the nature of it differed at the college level. The math-oriented groups' jobs were more likely at this level to be related to their majors and occupational plans. Table 9 provides information on the extent of the work experience of the two groups during their academic years. It also examines the relationships of summer and college jobs to the majors and occupations of the respondents.

Academic Factors: Math Classes, Math Achievement, Math-Related Activities: Math Courses Taken: On the average the math-oriented respondents took almost five math courses in high school compared to an average number of 3 1/3 courses for the non math-oriented group; i.e., the math-oriented respondents as high school students took approximately 1 1/2 more math courses than their non math-oriented counterparts. As Table 10 shows the math-oriented respondents were also more likely to take upper-level math courses. However, as this same table shows the majority of both groups did not take these upper-level courses (college or advanced algebra, intermediate geometry, analytic geometry, calculus, probability and statistics, or elementary functions).

Approximately two-thirds of the math-oriented respondents took one or more advanced-level math courses in high school compared to less than one-fourth of the non math-oriented respondents (65% and 22%, respectively). For the six non math-oriented respondents who indicated they had taken an advanced-level math course there were no differences in terms of performance or number of courses taken between them and the math-oriented respondents who had enrolled in advanced-level math courses at the high school level.

On the average, the respondents in both groups reported the same level of math achievement. The non math-oriented respondents generally reported grades the equivalence of a B average in their math courses whereas the math-oriented respondents reported the equivalence of a B+ average in their high school math courses.

At the junior high school level both groups reported that their average grades were in the B range (B and B+, non math-oriented and math-oriented, respectively). There was a strong correlation between junior high school grades in mathematics and high school mathematics grades (r=.65). Junior high school math grades also correlated positively with the number of high school math courses but not as strongly (r=.52).

Persons Influencing Selection of High School Math Courses: School personnel, namely high school and junior high school teachers and counselors, were identified by the math-oriented group as being the most important persons in helping them to decide what high school math courses to take. Parents (mainly fathers) were cited as another source of advice.

Over half of the non-math-oriented group (52%) did not respond to this question or identify anyone. Of those who did, most identified high school and junior high school teachers and counselors. On the other hand ministers, relatives and friends were cited by the respondents as being the least influential persons in their selection of high school math courses. Tables 11 and 12 show these results.

Math-Related Activities: Respondents were asked to identify the extent to which they participated in a number of math-related activities: at the present time (of the interview), in college, in high school, and in junior high school. The results of these analyses are presented in Table 13. As these data indicate most of the respondents had a low level of participation in these specific activities. Generally, there were no significant differences between the two groups. However, on some activities the math-oriented group had a slightly higher level of involvement. These included attending math-related lectures, reading books on mathematics, talking to friends about mathematics, and solving math puzzles. These differences generally held across the college, high school and junior high school levels, but not at the adult professional level. While the respondents were supposed to respond in terms of extracurricular activities, it may be that their responses reflected their activities in and around their math classes.

A summary measure was created for the math activities at each level. A one-way analysis of variance was performed on each measure using group membership as the independent variable. At the junior high and college levels, the F-test approached statistical significance at the .05 level (.0522 and .0652, respectively). On all but the present math activity scale, the math-oriented group had higher mean scores indicating participation in more of the specific activities.

Self-Assessment of Math Abilities: The respondents were asked to compare themselves in terms of abilities to solve math problems with their classmates at the graduate school, college, high school and junior high school levels. In each case a higher percentage of the math-oriented group indicated that they believe themselves to be more capable than their classmates. Table 14 presents these results.

Likewise, when asked if their grades accurately reflected their math abilities a higher percentage of the math-oriented group responded in the affirmative. These results are presented in Table 15. These findings are consistent with the reports on math achievement, where the math-oriented group reported higher grades at the high school and junior high school levels, and higher rates of participation in more advanced math courses.

Attitudes Towards Math Classes and Math Teachers: Respondents were asked to characterize their attitudes towards their last math class at the junior high, high school and college levels from a list of descriptive adjectives. At the college level the math-oriented and the non math-oriented respondents were very similar in selecting the adjectives which most characterized their experiences with their last college math class. Most identified it as interesting, challenging or enjoyable. Non math-oriented respondents were more likely to characterize their last math class at the college level as frustrating than were math-oriented respondents. These same results hold for the high school level as well. However, the math-oriented respondents were more likely to characterize their last high school math class as boring than were the non math-oriented respondents. At the junior high school level the math-oriented respondents were more likely to find their last math class in junior high school to be interesting or challenging, more so than the non math-oriented respondents. On the other hand, the non math-oriented respondents were more likely to find this course to be frustrating. Both groups were equally likely to find the course to be boring or intimidating. These results are presented in Table 16.

Respondents were asked the question "Do you think a good math teacher is more, as or less important than (as) ability when it comes to solving math problems?" The majority of the respondents in both groups felt that a good math teacher is more important than ability in mathematics learning. For the math-oriented group 61.5% believed that the math teacher is more important. For the non math oriented 50% felt this way. Almost 35% of the math-oriented group thought the math teacher was as important as ability and 46% of the non math-oriented group thought this. In each group only one person believed that the math teacher was less important than ability in mathematics.

On items measuring the respondents' perceptions of their math teachers and professors and of the attitudes of these persons toward math no essential differences between the two groups were revealed. At the junior high school level the math-oriented group was more likely, however, to find their teachers enthused about teaching mathematics.

Favorite and Least Favorite Subjects: When the favorite or least favorite academic subjects of the respondents are examined, clear differences emerge between the two groups. At both the high school and junior high school levels, the math-oriented group generally indicated math or natural or physical sciences courses (including industrial arts) as their most favorite academic subjects. They were less likely to indicate the social sciences, the humanities or arts as favorite courses. On the other hand, non math-oriented respondents were more likely to indicate that math and the natural and physical sciences were their least favorite subjects and more likely to express a preference for the social sciences, humanities and arts. These data are presented in Tables 17 and 18.

Factors and Persons Influential In Selecting Occupations, College Majors and Math Courses: Occupation: Many respondents in each group had decided upon an occupation by their teen years (13-18 years of age). However, in both groups large numbers waited until they were 19 or older to choose an occupation. Also, in both cases many people did not respond to this item. (See Table 19.) Closer examination of the answers shows that some of the respondents had changed careers after leaving college and that the later age sometimes refers to the time when they selected their new occupation.

For both groups, family and friends were the primary source of information about the occupation. Recruiting efforts (career days, counseling, college recruiters, etc.) also played a dominant role for math-oriented respondents in their learning of their chosen occupation. The media and published literature also played a role for both groups. When the various educational sources (high school and college classes and teachers) are combined they represent a major effect as well. Data for this analysis are presented in Table 20.

The two groups showed marked differences in their primary reasons for choosing their chosen occupation, as Table 21 suggests. People in the math-oriented group often cited the challenge, the appeal, or the compatibility of the occupation with their interest or aspirations as their primary reason. The primary reasons choosen by the non math-oriented group had to do with the community or human aspect or focus of the occupation they chose. The respondents' previous educational or work experience also contributed to their selecting an occupation. For the math-oriented group another primary reason was the benefit of the occupation (material and prestige).

In response to the question "Did you know somebody in this field?" most of the respondents in both groups indicated that they did. They generally listed friends, relatives, co-workers, employers, and teachers as the people whom they knew in this occupation. (See Table 22.)

The respondents were asked to identify the most important person influencing their occupational choice. A family member or relative was the most frequently cited individual by the math-oriented group followed by school personnel (college and high school teachers). Non math-oriented respondents cited school personnel (again high school teachers) most frequently, followed by family members, relatives, and friends and peers. (See Table 23.) For the math-oriented group the father was one of the leading persons instrumental in the occupational choice of the respondent. High school teachers and college professors were other important persons. These respondents also cited themselves, or other persons such as their spouses, girlfriends or boyfriends. For the non math-oriented persons college professors, mothers and peers were often named as the most influential persons.

As for the least important persons influencing their choices the respondents generally cited family members, relatives, and school personnel. (See Table 24.) For both groups neighbors, grandparents, and ministers were cited as the persons having the least influence on occupational choice. For math- oriented people, high school and college counselors were generally listed as persons who were not very influential in their choice of an occupation.

College Major and Math Courses: Several factors related to selecting a college major were explored. The reason cited most frequently by respondents in both groups was professional aspirations. That is, their college major was compatible with their professional goals. Another frequently cited reason for the math-oriented respondent was the challenging or appealing aspect of the subject matter itself. Interestingly, almost one-fourth of the non math-oriented respondents indicated that they did not have a specific reason for selecting their college major.

For both groups, school personnel were most frequently cited as being influential in choosing the college major followed by family members and relatives. The math-oriented respondents identified themselves, their high school teachers and their fathers as the most significant figures in selecting their college majors. For the non math-oriented persons, college professors and mothers were significant individuals. On the other hand, high school and college counselors played almost no role in the process of college major selection. This is particularly true for the math-oriented group. The least important person for these respondents were identified as neighbbors, grandparents and college counselors.

In terms of selecting college math courses, the math-oriented respondents identified college counselors, college professors and parents as the most important persons. The non math-oriented persons also identified college counselors, college or high- school teachers, and parents. As a rule, they generally identified neighbors as the least important persons in assisting them with this choice. Tables 24 through 27 present the results of these analyses.

Math and Society: Several questions were posed to the respondents soliciting their opinion of the relative importance of mathematics in modern-day life. One question asked the respondents their opinion of the importance of mathematics compared to other subjects in everyday life. Generally, both groups felt that math was as important as other subjects. A larger percentage of the math-oriented respondents felt that math was more important than other subjects. When asked about the importance of a good background in mathematics for getting a well-paying job, the two groups differed significantly in their assessment. For the math-oriented group, a vast majority (72% felt that a good math background was very important while 28% felt that it was somewhat important. On the other hand, 48% of the non math-oriented group felt that it was somewhat important while 41% felt that it was very important. Three persons among the non math-oriented group felt that a good math background was unimportant in getting a good-paying job. In response to the item which asked about the relationship between employment in a profession or occupation beneficial to the Black community and the importance of a good math background no difference was found between the two groups. Furthermore, the majority of people in the two groups did not see math as being any more important than other subjects for the advancement of society. The results of these analyses are found in Table 28.

An additive summary scale was created consisting of responses indicating a great deal of importance for math in social settings (the Math and Society scale). A one-way analysis of variance was performed using this scale as the criterion variable. This analysis showed no difference between the two groups on this measure of the societal usefulness of mathematics.

Personal and Psychological Variables: A number of variables measuring the attitudes of the respondents toward mathematics have been discussed. In addition to these variables, measures of value orientation, church attendance, religiosity and racial awareness were administered to the respondents.

The majority of the respondents in both groups indicated that they attended church at the time of the interview as well as during their college, high school and junior high school days. For the most part they were frequent church attenders. Table 29 presents these data. Also, on a measure of religious values, no differences was found. These findings would suggest that religion is equally important for both groups and have been throughout most of their lives.

To measure the value orientations of the respondents a test of value activities developed by Shorr in 1953 (reported in Robinson and Shaver, 1973, pp. 508-513) was used. According to Robinson and Shaver (1973): "This scale assesses the intensity with which individuals hold four kinds of values: theoretical, social, aesthetic, economic-political." For the theoretical scale a high score indicates that the individual prefers and considers most worthwhile those activities which involve a problem-solving attitude and is related to investigation, research and scientific curiosity. A high score on the economic-political scale indicates that an individual prefers the accumulation of money and the securing of executive power. The aesthetic scale is a measure of a person's preference for activities which involve art, music, dance and literature. The social scale measures an individual's preference for those activities which involve service and help to people and which exhibit a definite desire to respond and be with people socially (Robinson and Shaver, pp. 510-511).

The racial awareness measure consisted of three subscales: Black communalism, Black identity and interracial commitment. Black communalism is a measure of the extent to which a person adheres to racial solidarity. Black identity is a measure of one's racial self-esteem, and interracial commitment is a measure of one's preference for interracial relations.

For most of these scales no significant differences emerged between the two groups. It may be that the two groups did not differ significantly on the theoretical scale, even though it is purported to be a measure of scientific curiosity (among other things), because of their high level of intellectual accomplishment and professional interest.

The two groups did differ significantly on the economic-political scale and the social scale. As a matter of fact, both groups had mean scores on the social scale which were higher than their mean scores on all the other scales, suggesting a strong social orientation for both groups. On both of these scales the non math- oriented group had higher average scores than the math-oriented respondents, indicating that they had stronger preferences for these kinds of activities (economic, political, social). (See Table 30.)

On the three measures of racial awareness a significant difference was observed between the two groups only on the Black communalism scale, in favor of the non math-oriented group. This higher mean score would suggest that this group adhered to the concept of intraracial solidarity more strongly than those with math backgrounds. However, the scores on the Black communalism scale and the Black identity scale indicate that respondents of both groups had strong attachments to both of these notions. And in both groups commitment to interracial relations was moderate. (These were five point scales with 5 showing the strongest commitment.) These results are presented in Table 30.

VIII. Model Building

High school mathematics coursework is seen by many as the key ingredient to a successful career in science, engineering, technology, or some other math-related occupation, even though it could be argued that antecedent variables such as attitudes towards and prior experience with mathematics and science may be important factors as well.

To determine the variables that account for the variation in high school math coursework, a series of regression models were developed. Four groups of variables were used in the different models. These are: family background variables (father and mother education; family influence in selecting high school math courses); school variables (math achievement in high school, school personnel influence in selecting high school math courses, junior high school math performance); personal variables (math importance and the various values subscales); and a measure of community effect (influence of non-family and school persons in selecting high school math courses).

Given the exploratory nature of this work, these analyses have the purpose of determining the relative strength of these various types of variables, singularly and in combination, in explaining the variance in the number of math courses taken in high school by the respondents. Since there is a relationship between the number and level of math courses enrolled in by the respondents, it is safe to assume that these analyses shed some light on the process of engaging in math-oriented professions.

A regression model was developed that regressed the number of high school courses on a set of variables from the four groups; namely,

- typical junior high school math grade
- grade point average in high school math courses
- scores on the social and math importance scales
- mother's and father's education
- school influence in choosing math courses
- family influence in choosing math courses
- community influence in choosing math courses

This model was ran for the entire sample, and for the two groups individually.

Similiarly, models examining the relative effects of family variables were ran for the entire sample and for each of the two groups. The same type of analysis was performed using personal/psychological variables, and school/academic variables. The results of these regression analyses are presented below.

The "full model" with variables from the four groups in the equation accounted for almost half of the variance in the criterion variable, number of high school math courses, (Multiple R= .67, R-square= .45) for the entire sample. For the math-oriented group, this combination of variables accounted for 42% of the variance (Multiple R= .65, R-square=.42) . With the non math-oriented group, this model accounted for 56% of the variance (Multiple R= .75, R-square= .56).

In the model for the entire sample, the primary variables, as determined by the standardized regression coefficients, were school-related: (1) influence of school personnel (i.e., high school and junior high school teachers and counselors) and (2) typical junior high school grades. Together they shared 36% of the variance with the criterion variable (Multiple R= .604, R-square= .365). These results indicate that the other seven variables shared less than 9% of the variance with the number of high school math courses taken by the respondents. For the entire sample, the sizes of the betas of the variables in this model are presented in Table 31.

When the math-oriented respondents are examined the principal variables that emerge from this regression model are: mother's education, high school math achievement (i.e. grade point average), and school personnel influence. (Stepwise regression analysis includes only the first two variables.) These three variables account for 34% of the shared variance with the criterion variable.

The regression analysis for the non math-oriented respondents yielded father's education, school personnel, high school math grade point average, and junior high school math grades as the primary variables associated with number of high school math courses. Combined, these four variables share over 53% of the variation. (A stepwise regression only retained junior high school math grades as a significant variable.) Table 31 contains the information on the relative contributions of the different variables in terms of standardized regression coefficients.

The regression models employing other subsets and combination of variables (i.e., personal and psychological variables, and math activities and perceptions of junior and senior high school teachers) did not yield significant results. Only the measure of religiosity showed some explanatory power with respect to the dependent variable.

These various findings suggest that school and academic-related variables (i.e. present and prior math achievement, school personnel) and family variables (parental education) are effects having an impact on the math course selection of the respondents, albeit in different ways for the different type of respondent.

While personal or psychological variables such as values or perceptions of math teachers, and variables related to extracurricular math activities do not appear to influence high school math course selection, they can not be totally ruled out. This is because with bivariate analysis involving math orientation some of these variables emerged significant, and because on many of these variables there was not a great deal of variation (i.e., these particular respondents were quite similiar with respect to some of these variables). It may be that these two groups of persons need to be contrasted with people in other, less professional occupations, and from different social backgrounds, more typical of the Black experience.

If time and resources had permitted, similiar detailed regression and bivariate analyses could have been performed on the other samples and these analyses would suggest how well these findings hold cross-sectionally, giving some idea of the process of Black professional development as it relates to math-based occupations.

From the available evidence it can be surmised that the selection of high school math courses is a function of student aspirations and interest, as well as previous and current success with mathematics, and family and school variables. Occupational aspirations, in turn, are a function of parental and familial characteristics (e.g., aspirations for children, socioeconomic status), school personnel influence, and specific recruitment efforts.

A high degree of participation in high school math courses seems to be directly associated with majoring in scientific and technical disciplines in college and in entering math-related occupations. As the data presented above illustrate, family and school variables extend to the college major and occupational choice levels.

II. Conclusions and Recommendations

This section draws conclusions from the analyses and results presented above. Also, it incorporates, where appropriate, findings from the other samples included in the larger study, in particular those from the high school and junior high school samples. This approach allows comparisons across age groups representing different stages of the process of professional development. As noted before, time nor resources permitted a more detailed analysis of the college sample data. Also, multivariate analysis of the high school and junior high school samples would be desirable. It is anticipated, however, that these analyses will be conducted at a later time when resource, time, and circumstances permit them.

In view of these limitations, some tentative conclusions can be drawn about the psychosocial factors influencing the participation of Black Americans in mathematics courses and related occupations. This study examined family, personal and psychological, social, and school influences on the math course and occupational choices of the respondents. Findings relative to these factors are reviewed below. Recommendations are also made following these discussions.

Family Variables

Results from the samples in this study and from other studies suggest that certain family characteristics are associated with a quantitative orientation, i.e. a tendency to be involved with math courses and math-related professions. The socioeconomic status of a family seems to be a key factor. The higher the family income and parental education, the more likely the respondent to have a quantitative orientation. These results hold consistently for the high school, college, and adult samples. With the junior high school students no relationship is found between parental occupation and career interests of students. This lack of relationship may be due to the lack of variation in the parental occupation variable. (Most students were from low-income or lower middle-income homes, with parents employed in the lower occupational categories or unemployed). Generally, these students' aspirations did not include scientific, technical or medical careers; less than 15% identified these professions as their career choice. Most opted for low-paying or low-prestige occupations, "glamour" professions (e.g., sports, entertainment), or had no firm career choices in mind. These findings suggest the influence of environmental factors on these students' career outlooks, or the lack of such. That is, media, peer, and family factors seem to help shape attitudes toward career options among this group of students.

Parental aspirations for their offsprings appears to be related to math orientation. In both the adult and high school samples, the math-oriented respondents reported higher levels of parental expectations and assistance in career choices and math course selections then did the non-quantitative respondents. However, with both groups in the two samples, parental assistance and expectations were high, a finding consistent with other research in this area. It should be kept in mind that these two samples are not very representative of the general Black population because of their relatively higher level of family affluence, i.e., a higher percentage of persons from middle-income families.

At a time when considerable attention is again being focused on the household composition of Black families, family structure looms as a variable of interest. In the three older samples most of the respondents reported coming from intact households. However, specific comparisons by orientation are available only for the adult sample at this time. In this case, math-oriented respondents held a slight edge in growing up in two-parent households (66.7% vs. 59.3%), but the difference is not statistically significant. It is difficult to conclude or even to suggest that family structure is an important variable in its own right since it is well established that family structure varies with socioeconomic status. Further study with a more heterogeneous and representative sample would shed more light on the question of the influence of family strucutre on the math orientation of Black Americans. Such a study would bo warranted given the alarming rate at which many

Black children find themselves in single-parent homes.

Furthermore, given the evidence of parental influence, especially paternal influence, in the decision making and selection processes concerning mathematics, such a study would be especially desirable. A more in-depth analysis of the data collected in this study could provide some information, perhaps in the form of testable hypotheses, but a larger, more focused investigation would still be required to examine this possible relation. At the very least, it can be stated that the father or father-substitute consistently played an influential role in the academic and professional lives of the respondents. The effect of father absence on the variables of interest is not known at this time.

In summing up the family role in mathematics course selection and career choice, it is clear that at important stages in the process family variables play a part. In some instances, family members are cited as an important or the most important influence (e.g. knowledge of occupation, occupational choice, choice of college major, high school math courses selection).

This familial role, however, can not be easily isolated. It may influence the other types of variables, such as personal motivation, attitudes toward and experiences with math and science, selection of schools and neighborhoods, which also have some relationship to math orientation. A larger sample would be needed to tease out these kinds of relationships, even though preliminary models could be developed with the data at hand.

Another aspect of the familial role is that not all relatives are equally important. Despite the fact that Black family life is characterized by a high degree of extended familialism, grandparents and other relatives individually are not major influencing agents in the matter of math orientation. As a matter of fact they were frequently cited as being unimportant persons in terms of the processes involving the choice of math courses, college majors, and occupations. Parental influence appears to be greater than that of other family members.

Personal and Psychological Variables

Some of these variables some to be more important than others as distinguishing factors. For example, a helping orientation characterizes the adult sample as a whole, but is more pronounced among the non math-oriented persons. Among the high-school respondents, the non-quantitative students were more attracted to professions that entailed this dimension. This finding is consistent with other studies and a theoretical formulation which posits a communalistic frame of reference for Black Americans emanating from their African heritage. Measures relating to the concepts of "people orientation" and "Black communalism" showed significant differences between the two groups at the adult level, as did a measure of political-economic interests. Again, it would be interesting to see if these relations hold among the other samples.

On the other hand, measures of religiosity, theoretical and aesthetic values, societal importance of math, and attitude towards math teachers did not yield statistically significant differences in the adult sample. In the high school sample, on specific items measuring the societal usefulness of mathematics differences were found between the two groups. With the junior high school students they generally felt that math was an important subject for many areas of life.

While non-quantitative adult respondents showed a greater feel for social and people issues, the quantitative group was more inclined to be attracted to scientific, technical, and mathematical subject matter because of its intrinsic appeal, challenge, or structure. They were also more likely to dislike courses in the humanities and social sciences.

While it is possible to identify these subjective or personal differences among people of different math orientations the data do not suggest why they exist. This area is an excellent candidate for further investigation. A host of research questions can be posited around these findings. Are these differences linked to basic personality differences, environmental influences, childhood experiences, etc.? Current research in Black child development may offer some insights into this issue.

In general, apart from the mathematical orientation of the adult respondents, some personal or attitudinal variables show significant and substantial relationship to math achievement and math course taking. (See Table 32.) These findings indicate that personal or psychological variables need to be taken into account for research, policy, and program development purposes.

Social Variables

Overall, most of the variables in this category do not seem to have a major impact on the math orientation of the respondents. However, one should not be too hasty to draw the conclusion that these types of influences are not important. As the data from the junior high school sample suggest and as reported by the adult respondents, outside influences can affect, for example, perceptions and choices of career possibilities. It can only be concluded that in this particular study the variables measuring the social environment do not seem to be significant factors. If other variables had been included in the study the results may have been different.

Nonetheless, some variables did appear to be worthy of note. Math-oriented adult respondents had a slightly higher degree of interracial experience in terms of neighborhoods and schools, but almost 71% of them grew up in Black communities, and the majority attended predominately Black high schools and junior high schools. This greater degree of involvement in predominately white schools may have exposed some math-oriented respondents to more math and science curricula and school personnel thus enabling them to develop competencies and/or a preference for these subjects. Again, this speculation can serve as a testable hypothesis in a future study or be studied by analysis of data from the current research.

Extracurricular activities and work experiences did not differ for the two groups of adult respondents. (The only exception is in the type of college summer jobs.) "Influential others" from the community (neighbors, friends, ministers, etc.) did not substantively impact the process of selecting math courses, college majors, or occupations.

Church attendance was high for most of the adult respondents during each level of their schooling, and religion appeared to be an important aspect of their lives. Interestingly, when the number of high school math courses was regressed on a set of personal/ psychological variables, the measure of religiosity emerged as the most important variable for the entire adult sample and for the math-oriented respondents only. However, only a small amount of variance in the criterion variable was accounted for by these equations. Further, it is difficult to provide a substantive interpretation to these results. Particularly since this measure is of present religious values. Nonetheless, given the fact that this measure of religiosity correlates significantly with a number math-related variables (weighted high school math grade point average, number of high school math course, present math-related activities, and influence of school personnel in selecting math courses), it seems worthwhile to note this variable as one for further theoretical or empircal consideration.

School Variables

Within the context of the educational system, clear differences emerged between quantitative and non-quantitative respondents. First, in the case of the adult sample, math-oriented persons were more likely to have enrolled in higher level math courses. With the high school students, those students who had taken three or more years of college preparatory math were by definition math-oriented, and they indicated a stronger liklihood of pursuing four-year college programs, and a professional occupation.

Second, adult math-oriented persons reported slightly higher grade point averages at both the high school and junior high school levels. When grades are weighted in favor of level of difficulty of the math courses, significant differences are found between the two adult groups, the math-oriented respondents having higher weighted math GPAs. These data are not available for the high school sample, and were not analyzed for the college group.

Third, as reported above, math-oriented respondents generally preferred math and sciences courses in high school, and dislike the humanities and the social sciences. Conversely, non-quantitative persons were more likely to prefer humanity and social science courses and to indicate math and sciences courses as their least favorite ones. These differences were observed across the two samples for which the data have been analyzed.

Within both samples math-oriented persons were more likely to report a higher level of extracurricular math activity. However, it is not clear that this is independent of math class assignments and activities.

A fifth area of interest is the attitude toward math teachers. The data from the three samples (adult, high school, and junior high school) show that most persons, irrespective of their math orientation, reported positive or favorable feelings about their math teachers.

The influence of educational professionals, including junior high school, high school, and college teachers and counselors is an important and interesting area of study. Findings from this study reveal that school personnel play mixed role in the math coursework and career selection processes for the high school and adult samples.

Adult respondents identified teachers as influential persons at different stages in these selection process (e.g. awareness of occupation occupational and college major choice, advice on selecting matah courses). Whereas counselors, particularly at the high school and college level, were not reported to be very helpful. Junior high and senior high school teachers and counselors were identified as being influential in selecting high school math courses. As a matter of fact, regression analysis shows their influence to be one of the major variables related to the number of high school math courses taken.

With the high school students, school personnel often ranked behind parents as influential persons in the decision making processes. And high school counselors were deemed more important than high school teachers at this level in most of the decisions. However, since most of the students were from the same high school, it is not clear if these ranking are a function of this particular school and its staff, or if they would hold with students from other schools (or even at the same school, but with different samples, and at different time periods).

It does become clear from these findings that school personnel do play a role in the process of selecting math courses and math-related occupations. It appears that teachers and professors have a more active role than counselors, which suggests that the counseling function needs to be examined as it relates to Black students and their participation in math and the relationship between science couses and careers.

While family and school variables consistently loom large in the selection and decision processes of respondents, social and psychological variables also appear to have influence on the process. The interaction among these different variables, and the exact manner in which they influence the choices of Black Americans relative to mathematics are not clear at this point, but clues are offered by the existing body of data, and further analysis using other statistical techniques (e.g. regression and path analysis) should be fruitful in suggesting the nature of these interrelationships.

Recommendations

The findings presented in this report underscore the importance of persons and events early in the decision making process relative to selecting math courses and making career choices. Many of the efforts to redress the underrepresentation of Blacks and other groups in scientific and technical occupations have concentrated on the collegiate level. Solid evidence is presented indicating a number of factors of importance in this matter: family, schools, and individual attributes. And these come into play well before students enter college.

From the findings in this study it is possible to indicate areas in which additional effort is required to overcome the larger problem of Black underrepresentation. These areas include: Black family and community life; school and curricular issues; and personal factors.

Black parents play important roles in their children's futures. More attention and effort could be directed toward them by educational institutions and community organizations with the purpose of improving their ability to advise their children of career opportunities, and helping parents understand the educational prerequisites and pathways necessary to attain them.

More research is needed to understand the role of Black parents in fostering their children's interest in math and science at the earliest stages of the process of occupational and educational decision making. One aspect of this investigation may focus on child rearing practices as they pertain to stimulating characteristics conducive to scientific interests. This recommendation is made in light of the following facts: intrinsic factors such as self-initiative, a liking for mathematics and science subjects emerged as differentiating variables; and family variables appear to be important in this process. Some research on Black childrearing suggests that Black children are socialized and handled in such a way that this socialization may contribute to their people orientation, but not to the exploration of their environment.

Black families are also important in shaping the various attitudes of their children, especially those that were found to be related to certain math variables, namely, religion, intellectual curiosity (theoretical scale), and self-esteem.

Another area of Black family life that deserves more attention is the apparent lack of influence of relatives other than parents, given the high degree of extended familialism and family interaction among Black families noted by various scholars of Black family life. More research could be conducted to determine if other relatives are not involved in these processes because of lack of information, lack of involvement in certain spheres of the child's life, geographical distance, or because their influence is transmitted indirectly through the parents. Given the fairly high degree of contact between relatives, these persons could be targeted to be sources of positive influences on the math and science orientation of young Blacks.

The Black community by way of its organizations and institutions could be engaged in the effort to increase the number of Blacks in scientific and technical professions. The idea of community organizations serving as sources of information and training for Black parents to learn of opportunities for their children was mentioned above. Black scientific and technical organizations and civil rights and social welfare groups could demonstrate to Black parents and students the social relevancy of scientific and technical issues. They could point out the scientific and technical aspects of traditional social concerns of Black Americans (housing, employment, education, etc.).

The Black media (i.e. newspapers, radio and television stations and programs that are owned or operated by or oriented toward Blacks) could play a major role in presenting the Black scientific images: profiling current Black scientists, engineers, medical personnel and others and their responsibilities and duties; disseminating information on the Black heritage in science and technology, on Black pioneers and contributors; generating more public discussion on the impact of science and technology on the lives of Afro-Americans (and Africans.).

Interested groups could sponsor activities that encourage math and science activity and achievement among Black youth in out-of-school settings. For example, fraternal organizations could sponsor software development in Africana Studies, encouraging Black youths to use compute technology to explore their cultural heritage. Community science fairs are other activities that could expose Black youths to science and technology and encourage their appreciation and participation.

While teachers as a group are important influences, the results from the junior high school data suggest that they could be more involved in the process of career awareness and choices. It is not clear if teachers are aware of their potential to make positive contributions to their students' decision making process in this area. This could be explored in research with teachers. Also, the ways in which teacher influences affect the decision making process for Black students could be investigated.

Counselors do not seem to be fulfilling their functions of advising students and making them aware of the career opportunities available to them, and the educational requirements needed to attain them. In many school systems, counselors complain of being burden with many other duties and responsibilities which prevent them from devoting the time and effort to the consultation role. To the extent that this happens, then students suffer in terms of lost opportunities.

On the other hand, career day programs, recruiting efforts aimed at Black students, and similiar activities are important sources of information about career opportunities in math and science, and could be used by schools, colleges, and community organization to broaden the awareness and interests among these students. School-college-community collaboration could give rise to programs and activities that make information available to Black youths at an early age and in a direct manner (targeted at their parents, relatives, churches, youth groups, etc., as well as at them).

School curricula could be examined to determine how they influence Black students' attitudes toward math and science. Do teaching methods and practices, books and other instructional materials enhance or detract from the students' interest in the subject matter? Are alternative instructional technologies (such as computers, television, audio-visual equipment) useful in increasing these students' interest and achievement in these subjects? Do these different aspects of the curriculum differentially affect Black students of different backgrounds and with different attributes? Would the incorporation of materials on the Black contribution to different scientific and technical fields enhance learning among Black students? Would courses on the relevancy of scientific and technical issues affecting Black communities increase student awareness of, interest, and accomplishment in math and science? Do Black students exhibit different learning styles not accommodated by traditional curricula and teaching methods? These and many other questions pertaining to school curricula and Black students remain to be investigated.

From the data collected in this study, certain personal attributes appear to be worthy of further study. Initiative, self-motivation, persistence, a positive sense of one's mathematical ability, and a sense of purpose are all characteristics that seem to be associated with a quantitative orientation. Comments made by the respondents; the fact that some of them identified themselves as the influencing person in their decision making; the fact that they "beat the odds", so to speak, in attaining professional standing in occupations where Blacks are severly underrepresented; and given that they like the nature and structure of scientific disciplines and mathematics suggest that some underlying psychological factors, independent of the other variables (familial, school, etc.), may be operating. It would be interesting to explore the "psychology" of Black scientifically oriented persons to see what make them "tick"; to see if these characteristics are unique to them, if they have been fostered by certain social environments and educational settings; and to determine if they can be inculcated in others by various methods.

While this study may have contributed to the understanding of the factors influencing the selection of math courses and math-related occupations, it also gives rise to a host of other issues and questions to be addressed by the research, educational, and practitioner communities. As an area of study and action, the issue of Black underrepresentation in the fields of science and technology promises to be challenging, interesting, and socially important.

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Table 1
College Major by Math Orientation

Classification

College Major	Math Orientation	Non-Math Orientation
Math	2	0
Engineering	12	0
Science	5	5
Business-Related	1	6
Social Sciences-Humanities	0	14
Education	5	2
Not Reported	1	0
	26	27

Table 2

Current Occupation by Orientation

	Orientation	
Current Occupation	MO	NMO
Accountant/ Business-Related	1	7
Social Services Professional	0	3
Non-Math Educator	0	6
Legal Professional	0	6
Psychologist/ Counselor	0	5
Math, Science Teacher	5	0
Physician	2	0
Engineer	9	0
Scientific/ Technical Personnel	9	0
Totals	26	27

Table 3

Parental Presence	Group Math-Oriented	Non Math-Oriented	Overall
Both Parents	66.7	59.3	62.7
Mothers Only	8.3	29.6	19.6
Fathers Only	4.2	3.7	3.9
Neither	12.5	3.7	7.8
No Response	8.3	3.7	5.9
Totals*	100.0	100.0	100.0
N	24	27	51

*(Totals in this and the following tables may be more or less than 100.0 because of rounding errors. They will be reported as 100.0.)

Table 4

Parental
Urban Experience

	Mother		Father	
Locale	MO	NMO	MO	NMO
Urban	45.8	40.7	45.8	37
Rural	33.3	25.9	37.5	29.6
Small Town	20.8	14.8	12.5	14.8
Suburban	0	0	0	7.4
Totals	100.0	100.0	100.0	100.0
N	24	27	24	27

Table 5

Parental Aspirations

	Father		Mother	
	MO	NMO	MO	NMO
H.S. Diploma	7.7	3.7	3.8	7.4
B.A./B.S.	30.7	25.9	53.9	29.6
Grad/Prof. Degree	30.7	18.5	19.2	18.5
Highest Possible/ According to Respondents' Hopes	11.5	18.5	15.4	14.8
Don't Know	11.5	14.8	7.7	11.1
No Response	7.7	18.5	0	18.5
Totals	100.0	100.0	100.0	100.0
N	26	27	26	27

Table 6

Parental Assistance with College Education

	Mother		Father			
	MO	NMO	MO		NMO	
Assisted	79.2	88.9	79.2	(86.4)*	63.0	(85)
Did Not	20.8	11.1	12.5	(13.6)	11.1	(15)
Not Applicable/ No Response			8.3		25.9	
Totals	100.0	100.0	100.0	100.0	100.0	100.0
N	24	27	24		27	

*(The numbers in parentheses represent the percentages for fathers in the household)

Table 7a

Racial Composition of Neighborhood of Upbringing

	MO	NMO	Overall
Predominately Black	70.8	88.9	80.4
Mixed	16.7	3.7	9.8
Predominately White	4.2	3.7	3.9
Not Reported	8.3	3.7	5.9
Totals	100.0	100.0	100.0
N	24	27	51

Table 7b

Racial Composition of Educational Institutions

	College		High School		Junior High School	
Composition	MO	NMO	MO	NMO	MO	NMO
Predominately Black	34.6	40.7	53.8	66.7	50	74.1
Predominately White	50	51.9	26.9	7.4	23.1	3.7
Racial Mix	0	7.4	11.5	14.8	3.8	3.7
Other	3.8	0				
Not Reported	11.5	0	7.7	11.1	23.1	18.5
Totals	100.0	100.0	100.0	100.0	100.0	100.0
N	26	27	26	27	26	27

Table 8

Extracurricular Activities

Hobbies

	College		High school		Junior High school	
	MO	NMO	MO	NMO	MO	NMO
Yes	73.1	63.0	65.4	74.1	53.8	59.3
No	26.6	29.6	26.9	22.2	34.6	22.2
N.R.	0	7.4	7.7	3.7	11.5	18.5
Totals	100.0	100.0	100.0	100.0	100.0	100.0
N	26	27	26	27	26	27

Sports

	College		High school		Junior High school	
	MO	NMO	MO	NMO	MO	NMO
Yes	69.2	51.9	69.2	81.5	50.0	48.1
No	30.8	40.7	26.9	18.5	30.8	33.3
N.R.	0	7.4	3.8	0	19.2	18.5
Totals	100.0	100.0	100.0	100.0	100.0	100.0
N	26	27	26	27	26	27

Table 8 (continued)

Organizations/Volunteerism

	College Clubs		College Volunteer Work		High School Clubs		Junior High School Clubs*	
	NO	NNO	NO	NNO	NO	NNO	NO	NNO
Yes	88.5	88.9	46.2	63.0	96.2	81.5	61.5	18.5
No	11.5	11.1	42.3	25.9	0	18.5	26.9	63.0
N.R.			11.5	11.1	3.8	0	11.5	18.5
Totals	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
N	26	27	26	27	26	27	26	27

*(p <.006)

Table 9

Work Experience

Employed	College		High school		Junior High school	
	MO	NMO	MO	NMO	MO	NMO
Yes	88.5	88.9	69.2	63.0	19.2	22.2
No	11.5	11.1	30.8	37.0	76.9	59.3
N.R.					3.8	18.5
Totals	100.0	100.0	100.0	100.0	100.0	100.0
N	26	27	26	27	26	27

	College Job Related to Major		College Job Related Occupation		Summer Job Related to Major		Summer Job Related to Occupation	
	MO	NMO	MO	NMO	MO	NMO	MO	NMO
Yes	38.5	18.5	23.1	18.5	65.4	25.9	42.3	14.4
No	38.5	66.7	57.7	63.0	30.8	63.0	50.0	70.4
N.R.	23.1	14.8	19.2	18.5	3.8	11.1	7.7	14.8
Totals	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100
N	26	27	26	27	26	27	26	27

Table 10

Math Courses Taken in High School

Math Course	Percent Who Took Course MO	Percent Who Took Course NMO
General Math	30.8	37.0
Pre-Algebra	34.6	29.6
Elementary Algebra	80.8	66.7
Intermediate Algebra	46.2	33.3
College Algebra	34.6	14.8
Advanced Algebra	26.9	5.7
Basic Geometry	65.4	70.4
Intermediate Geometry	15.4	29.6
Analytic Geometry	23.1	3.7
Trigonometry	69.2	33.3
Calculus	15.4	7.4
Probability & Statistics	0	0
Elementary Functions	15.4	3.7
N	26	27

Table 11

Most Important Person
Influencing High School Math Course Selection

	MO	NMO
Family/Relatives	19.3	7.4
School Personnel	57.6	40.7
Others	7.7	0
Not Reported	15.4	51.9
Totals	100.0	100.0
N	26	27

Table 12

Least Important Person Influencing
High School Math Course Selection

	MO	NMO
Family/Relatives	27.0	37.0
School Personnel	7.7	3.7
Others	30.8	29.6
Not Reported	34.6	29.6
Totals	100.0	100.0
N	26	27

Table 13

Math Activities By Orientation (Percent Responding "Always" or "Often")

	Level							
Activity	Presently		In College		In High School		In Jr. High School	
	MO	NMO	MO	NMO	MO	NMO	MO	NMO
Read Magazine Articles on Math	19.2	29.6	26.9	14.8	3.8	7.4	8.0	9.1
Read Newspaper Articles on Math	23.1	33.3	15.4	18.5	0	3.7	4.0	4.5
Watch TV Programs on Math	11.5	18.5	12.0	7.4	4.0	3.7	4.3	0
Attend Math-Related Lectures	26.9	18.5	50.0	25.9	19.2	7.4	16.0	0
Read Books on Math	32.0	29.6	53.9	37.0	53.9	25.9*	32.0	0
Talked to Friends about Math	34.6	48.1	76.9	48.1*	42.3	33.3	36.0	13.6
Do Non-Required Math Projects	NA	NA	19.2	18.5	19.2	18.5	16.0	13.6
Have Math Related Hobbies	30.8	18.5	23.0	11.1	11.5	14.8	12.0	9.0
Solve Math Puzzles	38.5	33.3	44.0	25.9	42.9	22.2	32.0	13.6
N	26	27	26	27	26	27	25	22

* The difference between the two groups is significant at $p<.05$.

Table 14
Respondents' Comparison of Their Math Problem Solving Abilities To Those Of Their Classmates (In Percentages)

	Level							
Self-Reported Capabilty	Graduate School*		College		High School		Junior High School	
	MO	NMO	MO	NMO	MO	NMO	MO	NMO
More	76.9	25.0	46.2	26.9	61.5	44.4	75.0	36.4
As	23.1	58.3	50.0	50.0	34.6	44.4	20.8	50.0
Less		16.7	3.8	23.1	3.8	11.1	4.2	13.6
Totals	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
N	13	12	26	26	26	27	24	22

* Difference between two groups significant at p <.03

Table 15

Math Grades Accurate Reflection of Math Abilities in High School and Junior High School

Accurate Reflections	Level: High School MO	Level: High School NMO	Level: Junior High School MO	Level: Junior High School NMO
Yes	80.8	63.0	82.6	65.2
No	19.2	37.0	17.4	34.8
Total	100.0	100.0	100.0	100.0
N	26	27	23	23

Table 16

Attitude Toward Last Math Class

Level

Attitude	In College		In High School		In Junior High School	
	MO	NMO	MO	NMO	MO	NMO
Interesting	30.8	24.0	28.0	40.7	34.8	18.2
Challenging	30.8	28.0	40.0	22.2	17.4	4.5
Enjoyable	19.2	4.0	4.0	14.8	13.0	22.7
Boring	11.5	16.0	24.0	7.4	30.4	27.3
Intimidating	0	0	0	0	4.3	4.5
Frustrating	7.7	28.0	4.0	14.8	0	22.7
Total	100.0	100.0	100.0	100.0	100.0	100.0
N	26	25	25	27	23	22

Table 17

Favorite Academic Subjects

	High School		Junior High School	
	MO	NMO	MO	NMO
Math	42.3	3.7	42.3	7.4
Natural & Physical Sciences	34.6	14.8	15.4	11.1
Social Sciences	3.8	40.7	7.7	18.5
Humanities & the Arts	19.2	33.8	19.2	25.9
Business-Related	0	7.4	3.8	0
N.R.			11.5	37.0
Totals	100.0	100.0	100.0	100.0
N	26	27	26	27

Table 18

Least Favorite Subjects

	High School		Junior High School	
	MO	NMO	MO	NMO
Math	11.5	25.9	3.8	25.9
Natural & Physical Sciences	7.7	14.8	3.8	0
Social Studies	26.9	7.4	23.1	7.4
Humanities & the Arts	26.9	40.7	26.9	22.2
Business-Related	3.8	0	3.8	
Physical Education	7.7	7.4	3.8	3.7
N.R.	15.4	3.7	34.6	40.7
Totals	100.0	100.0	100.0	100.0
N	26	27	26	27

Table 19

Age at Deciding Occupation

	MO	NMO
Pre-teens	3.8	11.1
13-18	34.5	37.0
19-25	19.2	14.8
Over 25	15.6	14.9
N.R.	26.9	22.2
Totals	100.0	100.0
N	26	27

Table 20

How Learn of Occupation

	MO	NMO
Family/Friends	23.1	25.9
Media/Publications	11.5	18.5
Recruitment Efforts	23.1	3.7
Professional in Occupation	7.7	14.8
High School	7.7	11.1
College	11.5	14.8
School, Instructor	3.8	7.4
Don't Know	7.7	3.7
N.R.	3.8	0
Totals	100.0	100.0
N	26	27

Table 21

Primary Reason for Selecting Occupation

Reason	MO	NHO
Challenging, Appealing Compatible with Interest	46.1	11.1
Community or People Oriented, Focus	7.7	22.2
Family Influence	3.8	11.1
Material Benefits or Prestige	15.4	11.1
Experience (Education, Work)	15.4	18.5
Teachers, Peers	3.8	14.8
N.R.	3.8	3.8
Totals	100.0	100.0
N	26	27

Table 22

Did Know Somebody in This Field ?

	MO	NMO
Yes	65.4	59.3
No	30.8	37
N.R.	3.8	3.7
Totals	100.0	100.0
N	26	27

Table 23

Most Important Person Influencing Occupational Choice

	MO	NMO
Family/Relatives	38.4	22.2
School Personnel	30.7	29.6
Friends, Peers	11.5	18.5
Other (Themselves, Girl/Boyfriend)	19.2	11.1
Missing	0	18.5
Totals	100.0 26	100.0 27

Table 24
Least Important Person Influencing Occupational Choice

	MO	NMO
Family/Relatives	30.7	37
School Personnel	30.7	11.1
Friends, Peers	3.8	14.8
Others (Neighbors)	19.2	18.5
Missing	3.8	3.7
Totals	100.0	100.0
N	26	27

Table 25

Reason for Choosing Major	Most Important Reason for Selecting College Major	
	MO	NMO
Professional Aspirations	30.8	37.0
Challenging, Intrinsic Nature of Subject	26.9	11.1
Rewards (Material Benefits, Prestige)	15.4	7.4
Tests, Counseling, Classes, Teachers	11.4	11.1
Limited Curriculum	3.8	11.1
Family Influence	7.7	0
Don't Know	0	22.2
N.R.	3.8	0
Totals	100.0	100.0
N	26	27

Table 26

Most Important Person Influencing Choice of College Major

	MO	NMO
Family/Relatives	22.9	22.2
School Personnel	26.9	40.7
Friends, Peers	11.5	3.7
Others	23.1	11.1
Missing	15.4	22.2
Totals	100.0	100.0
N	26	27

Table 27

Least Important Person Influencing Choice of College Major

	MO	NMO
Family/Relatives	26.8	22.2
School Personnel	27.9	18.5
Friends, Peers	3.8	3.7
Others	34.6	40.7
Missing	11.5	14.8
Totals	100.0	100.0
N	26	27

Table 28

Math and Society

The Importance of Math vs. Other Subjects for

Math Is __ Important	Everyday Life MO	 NMO	Societal Advancement MO	 NMO
More	20.0	11.5	15.4	14.8
As	60.0	84.6	76.9	74.1
Less	20.0	3.8	7.7	11.1
Totals	100.0	100.0	100.0	100.0
N	25	26	26	27

Importance	The Importance of Good Math Background for Well-Paying Job * MO	 NMO	The Importance of Good Math Background in Occupations that Benefit the Black Community MO	 NMO
Very	72.0	40.7	25.0	33.3
Somewhat	28.0	48.1	58.3	48.1
Unimportant	0	11.1	16.7	18.5
Total	100.0	100.0	100.0	100.0
N	25	27	24	27

* Difference significant at p<.05.

Table 29a

Church Attendance of the Respondents By Orientation

Attend Church	Currently		In College		In High School		In Jr. High School	
	MO	NMO	MO	NMO	MO	NMO	MO	NMO
Yes	73.1	81.5	53.8	70.4	84.0	88.5	87.5	81.0
No	26.9	18.5	46.2	29.6	16.0	11.5	12.5	19.0
Totals	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
N	26	27	26	27	25	26	24	21

Table 29b

Frequency of Church Attendence

Frequency	Currently		During College		During High School		During Jr. High School	
	MO	NMO	MO	NMO	MO	NMO	MO	NMO
More than once a week	0	0	15.4	21.1	14.3	17.4	28.6	27.8
At least once a week	16.7	50.0	61.5	31.6	52.4	60.9	42.9	55.6
Every other week	38.9	18.2	7.7	21.1	19.0	4.3	14.3	11.1
Once a month	27.8	9.1	15.4	5.3	9.5	0	9.5	5.6
Occasionally	16.7	22.7	0	21.1	4.8	17.4	4.8	0
Totals	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
N	18	22	13	19	21	23	21	18

Table 30

Mean Scores on Test of Value Activities and Racial Awareness Orientation

Group	Scale	Mean	Standard Deviation	Significance (T-Test)	N
Math-Oriented	Theoretical	72.5	21.7	.78	26
Non-Math Oriented		74.3	23.4		27
MO	Economic-Political	52.0	28.0	.0009	26
NMO		77.4	24.2		27
MO	Aesthetic	58.5	28.8	.15	26
NMO		69.4	26.1		27
MO	Social	73.3	26.6	.02	26
NMO		87.7	16.1		27
MO	Black Communalism	3.87	.55	.05	26
NMO		4.0	.96		27
MO	Black Identity	3.77	.90	.40	26
NMO		4.0	1.13		27
MO	Interracial Commitment	3.4	.47	.43	26
NMO		3.3	.84		27

Table 31

Standardized Regression Coefficents

Variable	Beta All	 MO	 NMO
School Personnel Influence	.3457	.3418	.4678
Typical Math Grades Earned in Junior High School	.3433	-.0547	.2716
High School Math Grade Point Average	.2044	.3778	.4597
Social (Values Subscale)	-.1861	.1304	-.0450
Math Importance Variable	.1420	.0840	.1117
Father's Education	.1300	-.1835	.4868
Family Influence	-.0578	-.2135	-.1319
Influence of Others	-.0503	-.0530	.1137
Mother's Education	.0327	.3898	-.0052

Table 32

Relationships (Correlational Coefficients) Between Math-Related Variables and Attitudinal Variables

	Math Variables			
Attitudinal Variables	H.S. Math G.P.A.	Junior High Math Grades	Number of High School Math Courses	Number of College Math Courses
Self-Assessment of Math Ability	.4557 (0.000)	.6422 (0.000)	.3541 (0.005)	.1006 (0.237)
Aesthetic Values	.048 (0.366)	-.0134 (0.462)	-.1621 (0.234)	-.0524 (0.355)
Theoretical Orientation	.2446 (0.039)	.2536 (0.033)	.0598 (0.335)	-.0618 (0.330)
Social Orientation	.0500 (0.36)	.1240 (0.188)	-.1121 (0.212)	-.3167 (0.01)
Economic-Political Values	.1081 (0.221)	.0285 (0.420)	-.0605 (0.334)	-.1790 (0.100)
Math and Society Scale	.2095 (0.066)	.1264 (0.183)	.1387 (0.161)	.1235 (0.189)
Religiosity	.2841 (0.02)	.2180 (0.058)	.2965 (0.016)	.1860 (0.091)
Black Communalism	.0075 (0.479)	.0636 (0.326)	-.0093 (0.474)	-.0188 (0.447)
Black Identity	.0211 (0.440)	-.0087 (0.475)	-.1007 (0.237)	-.1563 (0.132)
Interracial Commitment	-.0258 (0.427)	.1314 (0.174)	-.0505 (0.360)	-.0489 (0.364)

The number in parentheses is the level of significance.
Analysis is based on a sample size of 53.

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THE QUANTITATIVE ORIENTATION OF BLACK HIGH SCHOOL STUDENTS

by

Donna Lynn Blackwell

A dissertation presented to the
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Abstract

THE QUANTITATIVE ORIENTATION OF BLACK HIGH SCHOOL STUDENTS

By Donna Blackwell

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This study was designed to explore non-intellectual factors associated with the election versus non-election of advanced mathematics coursework by Black high school students. Two personal and two interpersonal factors were investigated. The personal factors are post high school educational and occupational aspirations, and attitudes toward mathematics. The interpersonal factors are parental characteristics (such as parental occupation and educational aspirations for his or her child) and the influence of others (i.e. counselors, teachers) on student coursework decisions and aspirations.

The sample consisted of fifty Black high school seniors; twenty-eight females and twenty-two males. Twenty-one students had taken three or more years of advanced mathematics and were labeled quantitatively oriented (QO). Twenty-nine had taken less than three years of advanced mathematics and were labeled non quantitatively oriented (NQO). All students resided in two suburban municipalities contiguous to the city of St. Louis.

A survey methodology was employed; a structured interview schedule was used to collect the data. The data are reported on the basis of raw frequencies, crosstabulations and chi square analysis.

Findings at the $<.05$ level of significance suggest the QO students differ from the NQO students in several ways. Parental educational attainment, income and aspirations for the students are positively associated with with quantitative orientation. Mathematics courses are clearly preferred over non-math courses by QO students. The NQO's enjoy both math and non-math courses. QO students are more likely to engage in extra-curricular math activities than are NQO students. The QO's are college or university bound; whereas, the NQO's are likely to consider a two year college or trade school as well as a four year college or university a viable post high school option. Similarly, QO's are single minded in their preference for white collar and prestigious occupations; whereas, NQO's are likely to be interested in blue collar occupations as well as white collar occupations. There is evidence that some NQO's are similar to QO's in their liking of math and their post high school aspirations. The fact that their math backgrounds are not adequate given their aspirations is attributed to a crucial information gap. There are no differences between the QO and NQO groups on the interpersonal dimension. There are three sex differences reported; they occur on the math attitudes and influential persons dimensions.

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TABLE OF CONTENTS

Chapter Page

Acknowledgments.............................iv

Table of Contents...........................v

List of Tables..............................vii

List of Appendices..........................xiii

1 BACKGROUND AND RELATED RESEARCH...........1

Background..................................1

Related Research............................5

The Scope of This Study.....................12

2 METHODOLOGY...............................15

Introduction................................15

Definitions.................................15

The Sample..................................17

Instrumentation.............................22

The Interviewers............................25

The Interviews..............................27

3 RESULTS...................................29

Introduction................................29

Overall Characteristics....................................30

Subgroup Comparisons.......................................56

4 DISCUSSION 62

REFERENCES..72

REFERENCE NOTES..72

REFERENCES...73

LIST OF TABLES

Number		Page
1	Reasons for Attending a Four Year College or University	44
2	College Major or Training Focus	45
3	Students' Occupational Aspirations	50
4	Students' Reasons for Occupational Choice	51
5	Comparison of Non Quantitatively Oriented (NQO) and Quantitatively Oriented (QO) Students by Gender	81
6	Comparison of Non Quantitatively Oriented (NQO) Students and Quantitatively Oriented (QO) Students by Family Income	82
7	Comparison of Quantitatively Oriented Female Students (QO) and Non Quantitatively Oriented Female Students (NQO) by Family Income	83

8 Comparison of Girls from Families with Incomes of Less Than $24,000 and Girls From Families with Incomes Greater Than $24,000 by Educational Aspirations 84

9 Comparison of Non Quantitatively Oriented (NQO) Students and Quantitatively Oriented (QO) Students Whose Mothers Attended College 85

10 Comparison of Non Quantitatively (NQO) and Quantitatively Oriented (QO) Students Whose Fathers Attended College 86

11 Comparison of Non Quantitatively Oriented (NQO) and Quantitatively Oriented (QO) Students Whose Fathers Have Occupational Preferences for Them 87

12 Comparison of Non Quantitatively Oriented (NQO) and Quantitatively Oriented (QO) Students by Least Favorite Subject 88

13 Comparison of Non Quantitatively Oriented (NQO) and Quantitatively Oriented (QO) Students Who Have Occupational Preferences by Least Liked Subject 89

14 Comparison of Non Quantitatively Oriented Female (NQO) and Quantitatively Oriented Female Students (QO) by Least Liked Subject 90

15 Comparison of Non Quantitatively Oriented (NQO) and Quantitatively Oriented Students by Attendence at Math Lectures 91

16 Comparison of Non Quantitatively Oriented (NQO) Females and Quantitatively Oriented (QO) Females by Attendence at Math Lectures 92

17 Comparison of Non Quantitatively Oriented (NQO) Females and Quantitatively Oriented (QO) Females by Math Hobbies 93

18 Comparison of Non Quantitatively Oriented (NQO) Males and Quantitatively Oriented (QO) Males by Frequency of Solving Math Puzzles 94

19 Comparison of Quantitatively Oriented Females and Males by Frequency of Having Math Related Hobbies 95

20 Comparison of Non Quantitatively Oriented (NQO) Students and Quantitatively Oriented (QO) Students by Rating of Importance of Math Related Occupations to the Black Community 96

21 Comparison of Females and Males by Rating of the Importance of Math Related Occupations to the Black Community 97

22 Comparison of Females and Males by Rating of Importance of Math to Society 98

23 Comparison of Non Quantitatively Oriented (NQO) Males and Quantitatively Oriented (QO) Males by Rating of Math Related Occupations Importance to the Black Community 99

24 Comparison of Non Quantitatively Oriented (NQO) Students and Quantitatively Oriented (QO) Students by Post High School Educational Aspirations 100

25 Comparison of Non Quantitatively Oriented (NQO) Females and Quantitatively Oriented (QO) Females by Post High School Educational Aspirations 101

26 Comparison of Non Quantitatively Oriented (NQO) Students and Quantitatively Oriented (QO) Students by Category of Occupational Aspirations 102

27 Comparison of Females and Males by Reason for Choosing an Occupation 103

28 Comparison of Non Quantitatively Oriented (NQO) Students and Quantitatively Oriented (QO) Students by Extent of Older Brothers Influence on Post High School Plans 104

29 Comparison of Females and Males by the Extent of Their Older Brothers' Influence on Their Post High School Plans 105

30 Comparison of Quantitatively Oriented Females and Quantitatively Oriented Males by the Extent to Which Their Fathers Influenced Their Post High School Plans 106

31 Comparison of Non Quantitatively Oriented (NQO) Females with Quantitatively Oriented (QO) Females by the Extent to Which Their Fathers Influenced Their Post High School Plans 107

LIST OF APPENDICES

Appendix		Page
A	Tables	80
B	Interview Schedule	108
C	General Instructions For Interviewers	109
D	Research Safeguard Statement	110
E	Parental Consent Form	111
F	Respondent Consent Form	112
G	Interviewer's Remarks	113
H	Interview Payment Voucher	114

CHAPTER 1

BACKGROUND AND RELATED RESEARCH

Background

There is a great need for professionals skilled in the mathematical and scientific disciplines. Our society is faced with many complex problems which raise new challenges in all sectors. The complexities of the issues, coupled with a tremendous dependence on technological solutions, require a continous supply of persons trained to improve the current level of technology or, at the very least, capable of using contemporary tools (Galambos, 1981).

Recognizing the importance of a well trained work force in the contemporary sense, educator after educator and commission after commission stress the need to encourage our youth to pursue careers in theoretical and applied mathematics and science. This obviously means that substantial numbers of the undergraduate college population must be encouraged to pursue the requisite undergraduate majors or areas of concentration. But even prior to this students must, by and large, be encouraged to obtain the requisite high school background courses which permit mathematical and scientific collegiate pursuits.

Because it is obvious that the senior high school years are so critical to the ultimate occupational objective, numerous researchers have examined the patterns of participation in advanced mathematics courses at that level (Havens, 1972; Ernest, 1976; Hedges and Majers, 1976; Melnick and Hamilton, 1977; Sells, 1977; Marrett and Gates, note 1). The research of these authors makes it clear that far too few students have the necessary high school math backgrounds to pursue mathematical and scientific undergraduate majors. Black students are particularly at risk as they are even more likely than white students to have serious mathematics coursework deficiencies. Furthermore, this failure to take advanced mathematics courses throughout high school may prevent a disproportionate number of capable Black students from even majoring in such non math and science majors as business on some college campuses.

According to the National Center for Education Statistics (note 2), there is a tendency on the part of Black high school students to discontinue taking mathematics courses after the tenth grade. This trend continues at the post secondary school level. The data from 1975 enrollment surveys conducted by the Engineering Manpower Commission of all known engineering schools and a large number of technology schools reveal that out of 4,017 engineering students, only 707 were Black; 73 were Black women. In technology programs the total Black enrollment was a meager 324.

There is also a paucity of Black Americans in mathematical, scientific and related professions. Hurst (1977) analyzed 1970 U.S. Bureau of Census data and found that of 1,233,148 employed engineers, 13,624 were Black men and 719 were Black women. Of employed architects, there were a total of 56,284 persons; 1,315 were Black men and 195 were Black women. Of 35,999 mathematical specialists, 1,622 were Black; Black women comprised less than 1% of the latter group. The same pattern exists in the life and physical science specialties where of 205,755 employed persons, 6,420 were Black; once again Black women constitute less than 1% of the latter group.

Westcott (1982), also analyzed Black male and female employment statistics. Her statistics were based on 1980 Bureau of Labor data, as well as the 1970 Decennial Census population counts. Accordingly, Black Americans constituted 9.4 percent of the national labor force in 1990. Black men were a little over 8 percent of employed men, and Black women accounted for almost 11 percent of employed women. In 1980, as was true in 1970, Black men and women were more likely to be employed in professions for which mathematical and scientific training is not required than those for which it is important if not essential. For example, almost 8 percent of male personnel and labor relations professionals were Black men. They were 16.4 percent of all male social and recreation workers and 15.2 percent of all male vocational and educational counselors. By comparison, Black women were 10.8 percent of women personnel and labor specialists; 17.4 percent of women social and recreation workers; and 17.8 percent of women vocational and educational counselors.

In spite their numerical deficiencies in quantitative fields, Black Americans have distinguished themselves as individuals (Carwell, 1977; Johnson, note 3; Hayden, note 4; Diggs, 1975),and as a race (Zaslavsky, 1975; Ploski and Williams, 1983) in mathematics and science. This coupled with the fact that Black students simply do not take sufficient amounts of high school math suggests that the current problem is in part a result of inadequacies in high school coursework selections (Cordes, 1983). In other words, unless more Black students obtain the requisite high school mathematics education the present pattern will continue. This education begins with at least three years of advanced or college preparatory mathematics prior to graduation from high school. By having this kind of background a student benefits in two ways: he or she is more likely to be admitted to an accredited college or university; second, the student will not be excluded from mathematics, science, technology and, in many instances, business majors (Sells, 1977).

A survey of area colleges and universities confirms that without at least three years of advanced high school mathematics courses (algebra 1 and 2; plane and analytic geometry; trigonometry; elementary functions, and so forth) it is very unlikely that a student could major in any mathematics, science or technology programs. Obviously, if one cannot major in these subjects one cannot be a "card carrying" member of any of the related professions.

While colleges and universities strongly recommend that high school students take at least three units (years) of advanced mathematics, the state of Missouri only requires a student to take one unit of mathematics--any kind will do! In 1978 only one third of the school districts in the United States required more than one year. Hence Missouri is actually part of the main stream (Kreinberg, 1982). As a consequence, most Black students have to elect advanced mathematics courses in order to comply with college or university recommendations. As this is the case, it is imperative that educators know the factors associated with a Black student's decision to elect or not to elect advanced mathematics courses when enrolled in high schools where these courses are offered.

Related Research

The research on attitudes toward mathematics and mathematics education is extensive (Aiken, 1970 and 1972; Sandman, 1973). Within this body of research and literature however, little attention has been given to the impact of personal and interpersonal processes on the interest of Black students in studying advanced mathematics and related subjects. The small body of research that does contribute to an understanding of factors and variables which bear on the interest in or selection of advanced mathematics courses by Black high school students is reviewed in this section. These studies are diverse in that the samples range from adult scholars and scientists to junior high school students to school districts. Second, each study employs a different type of research instrument. In spite of varying sampling techniques and sample characteristics, research time frames and instruments, several personal and interpersonal factors stand out as links to the problem at hand. Parental characteristics and socioeconomic status, as well as encouragement from significant others such as parents and teachers are apparently important background and interpersonal factors. The personal characteristics of import suggested by these studies are a person's sense of efficacy about his or her math ability, attitude toward the subject and post high school plans. To a lessor extent there are hints that extra curricular activities and gender related characteristics may also be relevant.

Scholars and Scientists. General academic achievement by Black Americans is associated with a variety of social factors. Bond (1972) surveyed 517 Black persons who had earned doctorate degrees and 247 of their classmates who had not. This sample consisted primarily of persons in non mathematical or scientific disciplines. He hypothesized that certain environmental factors differentiate between persons who distinguish themselves by scholarly attainment and those who do not.

Bond's data supported his hypotheses; family background, socioeconomic status, and the "psychological and motivational climates" of the school and community were important concomitants to scholarship and high achievement in general. The Ph.D.'s Bond surveyed tended to come from families headed by literate parents; additionally, most of their fathers were white collar professionals (occupational information about their mothers was not reported).

Young (1974) surveyed 221 Black scientists. Demographically, these persons were southern born and reared; attended predominantly Black schools; were for the most part, male and from low income families. Reading and, to a lesser extent, sports were the primary childhood interests of this group. While all the respondents reported positive attitudes toward education in general, forty percent indicated that success patterns in mathematics and science during their childhood and adolescence were the strongest factors influencing their choice of science as a career. Fifty percent of the respondents had decided on a science career by their second year of high school. Although for many of the respondents high school teachers and parents were important sources of encouragement, a full fifty percent reported that they chose science because of the "intrinsic value of knowlege."

There is an obvious contradiction between the Young and Bond studies. Young finds that most of his respondents are from low income homes; Bond's respondents are, by and large, of middle class origin. This difference may reflect the times in which each study was undertaken. Bond's study, while published in 1972, was conducted in the early sixties. Young's study was conducted in the early seventies. It is quite possible that Young's study shows the results of the spirit of the 60's which was to expand the educational, and economic opportunities of low income Black Americans. On the other hand, the Bond and Young studies may simply be an indication that Black scholars and scientists come from all socio-economic levels. The latter point is one that would meet with little resistance from the engineering professions. According to the American Society for Engineering Education, "Substantial numbers of (minority) engineers are produced by all socioeconomic levels and predictive models based on the socioeconomic origin of engineering students have little value" (Padulo, 1974).

College Students. Tilford and Allen (1974) surveyed Black college students at predominantly Black colleges and universities. They compared science and non-science majors on a number of variables: academic ability and achievement, characteristics of high school attended, attitude toward science, influence of others on the choice of major field of study, and family background.

These authors concluded that: (1) "pure" science fields attracted more academically able students; (2) that there are no differences in the family backgrounds of science versus non-science majors; (3) that high school science activity and level of school integration does not affect choice of college major; (4) that persons from the home and school are influential to varying degrees in the students' choice of their fields; and (5) that there was a difference in attitudes toward science favoring science majors. The conclusions of these authors must be considered with caution due to methodological limitations having to do with sampling and incomplete statistical reporting.

High School Students. Marrett and Gates (note 1) studied the enrollment of Black students in high school math classes by surveying 45 high schools. They examined overall enrollment, school size, teacher participation in school wide decision making, teacher views on conditions influencing students to elect math courses, and the operation of the counseling service. Their findings confirmed the limited and disproportionately low representation of Black students in high school level advanced math courses. They also found that Black females were more likely than Black males to enroll in advanced math courses. The other factors which related to participation were the availability of courses and the extent to which teachers encouraged math enrollment.

The Marrett and Gates research findings are at odds with the conclusions of many "math and sex" researchers. Essentially, the latter group has found that in the general or non-Black population women students are less likely to enroll in advanced math courses than men (Fennema & Sherman, 1977; Haven, 1972).

Junior High School Students. Bell (1974) studied self esteem among forty Black seventh graders in order to find out what the differences were between students who were successful and those who were unsuccessful in mathematics. After interviewing and administering the Coopersmith Self-Esteem Inventory to 20 low achieving and 20 high achieving mathematics students, Bell concludes the following: (1) high achievers tend to come from higher SES families than do low achievers; (2) high achievers have more positive mathematical self concepts than do low achievers; (3) high achievers have higher educational and occupational aspirations than do low achievers. There were no differences between the two groups in general self concept.

Bell's conclusions must be adopted cautiously because of the way she selected her sample. A child was labeled a high or low achiever based on scores from a standardized mathematics achievement test and teacher ratings, both of which tend to favor middle class children.

Johnson (note 5) studied Black junior high school students and searched for psycho-social influences on math attitude and interest. The sample was comprised of one hundred and fifty eight students from two inner city middle schools located in St. Louis. These students were from low to lower middle income families. According to Johnson, Black junior high school students generally like math, and have positive feelings about their math teachers. They also consider the subject valuable to occupations which are beneficial to society and the Black community. There was no relationship between parental background or math attitudes and high school coursework plans, much less occupational aspirations. Johnson concludes that there is frequently a gap between student attitudes and career orientation. That is, while they may like a subject like math they are not well informed about its importance to their future career options. Johnson also points out, and in this regard concurs with Young, that students who feel good about their math experiences and rate themselves high in ability are more likely to be interested in science careers. Johnson compared boys and girls in this study, but found no differences related to gender.

Like Johnson, Jacobowitz (1980) found no gender differences in self concept as it relates to math abilities. From her study of 261 Black junior high school students she also finds no difference between girls and boys on math and science achievement. Jacobowitz did however find that boys were more likely to have a science career preference than girls.

Summary. The results of the research reviewed suggest that certain personal and environmental factors may have explanatory properties as far as achievement in general and participation in math and science endeavors in particular are concerned. Such things as family background, attitudes toward math, educational and occupational aspirations, and encouragement from others are associated with the mastery and utilization of mathematics. This conclusion is based however on the findings of a small number of studies, involving different types of samples and utilizing an array of measures to collect the information. Furthermore, only one of these studies looked at the high school level, and none of them used a high school student sample.

The Scope of This Study

In the current study I acertained some of the factors which account for the fact that, in spite of high school education requirements to the contrary, some individuals are interested in electing advanced math courses and thereby mastering and utilizing mathematical concepts and skills. The conceptual and methodological emphasis was on select personal and interpersonal processes which appear to play a significant and explanatory role in the development of talent and interest in mathematics among Black high school students. Specifically, this research was designed to ask: what personal and interpersonal factors, singularly or in combination, distinguish between Black high school students who take three or more years of advanced mathematics and Black high school students who do not?

It was assumed that by examining select personal and interpersonal factors in the context of race and age, the general social and cultural factors that serve and have served as barriers to Black achievement in mathematics would be held constant. Thus, those factors which are influential in affecting the participation or non-participation in advanced high school mathematics by Black students in particular would emerge.

Earlier, it was pointed out that Black females are rare in mathematical, scientific and technological occupations. It was also noted that males are not as likely as females to enroll in advanced high school math courses. These findings gave rise to the question: are there factors which operate differentially depending on the gender of the Black student with respect to the election of mathematics courses?

A number of social factors have been associated with general academic achievement, as well as achievement in mathematics, science and technology. Of these factors, the influence of individuals who are in the student's immediate environment seemed particularly important. Hence, the study was also designed to determine if family members, school personnel, and peers are particularly influential in determining student coursework decisions.

The experiences students have in mathematics classes contribute to their attitudes about mathematics problem solving and therefore to their feelings about math courses. For this reason the students were asked to describe their feelings about their math classes and teachers. The students were also asked to name their most favorite and least favorite subjects. From their experiences with mathematics education students also obtain some, if not most, of their ideas about the relationship of math to society in general, and to their lives in particular. Thus, this study was designed to determine if students who elect three or more units of advanced mathematics courses in high school valued mathematics differently than the students who elect less than three years.

While discussed in greater detail in the next chapter, this research explored the questions and issues presented above through a standardized interview schedule. The null hypothesis was assumed because of the inconsistent results reported in the related research. The findings as reported in Chapter 3 are based on data which were analyzed by crosstabulation and chi square techniques.

CHAPTER 2

METHODOLOGY

Introduction

In this chapter the research methodology is described. In the first section the primary concepts and factors are defined. In the second section, the selection of the sample and some sample characteristics are reported. A more extensive description of the sample is reported in Chapter 3. The third section covers instrumentation, both development and administration. In the fourth and final section the collection of data is described.

Definitions

The terms advanced mathematics, quantitative orientation, quantitatively oriented, and non-quantitatively oriented will be used extensively from this point forward. Advanced mathematics is used to connote high school courses which are designated as college preparatory by St. Louis metropolitan area colleges and universities. This term would apply to such courses as elementary algebra, plane and analytic geometry, trigonometry, elementary functions, college algebra and introductory calculus. The complete list of courses designated as college preparatory or advanced math may be found in the interview schedule on page 21; items F through T (appendix B). Quantitative orientation is the extent to which a student is interested in the mastery and utilization of mathematical concepts and procedures as indicated by the amount of advanced mathematics coursework taken in high school. Students who have taken three or more years of advanced mathematics in high school are quantitatively oriented. Students who have taken less than three years of advanced mathematics coursework in high school are non-quantitatively oriented.

After a careful review of related research, a conceptualization of personal and interpersonal differences between quantitatively oriented and non-quantitatively oriented students was hypothesized. Accordingly, two personal and two interpersonal factors were deemed particularly salient and thus warranting examination. The personal factors under consideration are attitude toward mathematics and post high school aspirations. Attitude toward mathematics is defined in two ways. First of all, it is a student's remembered affect while engaged in mathematical problem solving settings. Second, it is a student's thoughts and feelings regarding the usefulness of mathematics in general, to society, to the Black community and to the student's career aspirations. The second personal factor, post high school aspirations, is defined as occupational and educational goals upon graduation from high school.

Recognizing that young people are frequently influenced by the people in their immediate sphere of activity, the interpersonal factors designated for further exploration were parental characteristics and influential others. The parental characteristics examined were educational attainment, occupation, and income, as well as educational and occupational expectations for their offspring. There are other people who formally and informally advise students. Teachers, counselors, peers, relatives, ministers and others who regularly interact with students may give counsel on decisions about coursework and careers. Those individuals who advised and are, according to the student, felt to have affected the student's decisions about math coursework, and post high school aspirations are deemed influential others. A standard listing of influential others may be found in the interview schedule on pages 23,32 and 38 (see appendix B).

The Sample

When this study was designed the sample was to be composed of 60 students randomly selected from four student populations within a single high school. Fifteen students were to be drawn from the population of female high school seniors who had taken at least three years of advanced high school math; fifteen from the male seniors who had taken three or more years of advanced high school math. Similarly, fifteen females and males were to be drawn from their respective populations of seniors who had taken less than three years of advanced high school math.

It was thought that members of each population could be identified through school records and recruited by letter. However, this methodology was not possible. Meetings were held with the high school principal, and the superintendent of schools during which the research goals, objectives and procedures were discussed. Responses to the overall aims of the research were very favorable but school officials rejected the proposed procedure for identifying and contacting the prospective student participants. They felt neither legally nor ethically free to give the investigator the necessary access to student records.

A second method for identifying and recruiting the sample was developed and submitted to school officials. This method involved having school personnel identify senior students and send recruitment materials to them. Recognizing this would involve considerable time and expense to the district, funds were offered to offset the cost of staff time and postage. This proposal was rejected also.

A couple of months after the second rejection by the school district, the investigator was asked to speak to the high school student body during Black History week. After accepting this invitation, I asked the school officials if it would be permissible to discuss this study and recruit students after the presentation on Black history was made. This request was agreed upon.

During an assembly of the entire student body, in the high school auditorium, I made a presentation on the achievements of Black Americans in various fields of endeavor; commerce and industry, science and invention, and education. After this presentation, a brief description of the research project was given. Seniors who were interested in participating in the study were asked to complete a form which had been placed on their seats prior to the commencement of the program. As the students departed from the auditorium they dropped the forms into boxes located in the rear of the auditorium.

Seventy-two students expressed interest in the study. These students were contacted and informed, by postcard, that within a short time a project staff person would contact them and make arrangements for an interview.

Of the seventy-two students who originally expressed an interest in participating only 47 were interviewed. The other students changed their minds and refused to participate when contacted by an interviewer.

The investigator attempted to encourage participation from students who initially agreed to participate but later declined. This was done by telephoning the students individually and asking them to reconsider their decision. Four students agreed to be interviewed, but when the interviewer showed up for the session at the appointed time and date the students were not there. No further attempts were made to enlarge this sample.

The superintendent of a comparable school district was contacted in an effort to recruit seniors from this district. The thinking was, if another sample of students somewhat approximating the original sample, could be recruited numerical deficiencies in the former sample could be offset. It was recognized that strategies for analysis would have to be modified accordingly.

The superintendent agreed to allow the investigator to give a presentation on the project to the students. The investigator described the research project to this second group of students in a manner similiar to that used at the first high school. The same forms were used to recruit students, the method for return of the forms differed however. In this case the principal asked, in front of the students, that the teachers collect the forms and give them to him. He in turn was to send the completed forms to the investigator. As it turned out only three forms were forthcoming. At this point efforts to obtain additional participants ceased.

All student respondents attended a predominantly Black suburban high school located in a suburban municipality which geographically boarders the city of St. Louis. In both cases the school was the only public high school in the district. Because the students were drawn from one school, for the most part, mediating variables which may have differentially influenced student choices were fairly well controlled. It should be noted from the onset that the modal tendencies of the three students from the second district are comparable to the other 47 in terms of SES, place of birth, parents' occupations, parents' educational attainment, and parents' birth place. Furthermore, the two districts were geographically side by side.

Ultimately, fifty high school students participated in this study. Females comprised 56% (n=28) of the sample ; 44% of the sample was male (n=22). The average age of the students was 18. The students ranged in age from 16 to 19 years. Ninety-six percent of the sample were unmarried while two of the students were married. Three of the girls reported having one child; none of the boys reported having any children. The overwhelming majority of the students were born and raised in the St. Louis metropolitan area; 86% of the students had lived in the area for over 16 years while 98% of the sample had lived in the area for at least 12 years. Eight-six percent (43) of the students were born in St. Louis, 88% or 44 students were born in the state of Missouri.

The student participants in this study were, for the most part, reared in areas that were either predominantly Black (75% or greater) or racially mixed (fifty/fifty Black-white ratio); 76% indicated that they were raised in areas that are greater than or equal to 50% Black. Since the St. Louis metropolitan area was at that time and is presently 47% Black, and the overall suburban Black population is 10.9%, it can be assumed that those students indicating they were raised in areas with predominantly Black populations were referencing their immediate neighborhood not the actual racial composition of the St. Louis metropolitan area.

It is recognized that most Black students attend public schools in the core city, not the suburbs. However, at the time this research was undertaken the St. Louis city public schools were in the throes of a contraversial desegregation effort. This precluded research on the students in this district. Secondly, given the pioneer nature of this research it was very important to have a substantial number of quantitatively oriented students in the sample. A smaller district with a relatively large pool of middle and lower middle as well as low income families was assumed to be the best starting point.

Instrumentation

Given the objective to explore memories and attitudes and aspirations, a survey methodology utilizing a personal interview and standardized interview schedule was developed. As Henerson and Fitz-Gibbon (1978, p.21) state, "Self-report procedures represent the most direct type of attitude assessment and should probably be employed unless there is reason to believe that the people whose attitude you are investigating are unable or unwilling to provide the necessary information."

Because of the tremendous resources required, the decision to study this problem via personal interviews was not an easy one. However, one cannot help but be attracted to an instrument described as "perhaps the most powerful and useful tool of social scientific survey research" (Kerlinger, 1973; p.412). Second, it is a well documented fact that the personal interview results in fewer incomplete or irrelevant responses and unanswered questions as compared with a questionnaire. Assuming that all interviewers are well trained, the respondent can get a clear understanding of the meaning for any given question. As compared with a written questionnaire, the structured personal interview offers greater flexibility in item construction, permits more probing, and more opportunity to detect and correct respondent misunderstandings. Finally, people are more likely to agree to participate in research when they feel all they have to do is answer questions. Those persons for whom writing is a burden are thus apt to participate whereas they might otherwise decline.

On the minus side, it is clear that exhorbitant amounts of time and money are inherent in the personal interview methodology. The construction of the final instrument, training of interviewers and scheduling of interviews took almost a full year. The actual interviews took an additional six months to complete. Fortunately, this research was funded as part of a larger study by the National Institute of Education. Thus the requisite time was available as was the money needed for developing and producing instruments, paying interviewers (not to mention the investigator), and a whole host of other necessities.

Based on related research (Sandman, 1973; Fennema and Sherman, 1976) the investigator developed a series of open ended questions. These questions were used in pilot interviews with area high school seniors, and newly admitted college freshmen enrolled in a special pre-college orientation program during the summer prior to their first college semester.

In the course of these interviews items which were vague, redundant, or confusing were apparent. At the close of each pilot interview the student was encouraged to talk at length about his or her math attitudes and reasons for his or her academic and career choices. These conversations were taped, transcribed and analyzed. As a result, new items were added to what ultimately became the final interview schedule. The ordering of questions also reflects the flow of those pilot interviews.

Prior to the design of the final interview schedule, the early versions were also reviewed and critiqued by members of the University's education and psychology faculty. Items were evaluated for content and construct validity, as well as clarity. For final measure two math educators, one of whom was also a senior researcher on math attitudes and education at the Central Eastern Midwest Regional Educational Laboratory (CEMREL), were consulted; they also evaluated and made recommendations on the interview schedule.

Interviews are frequently described as having either open ended or forced choice items (Kerlinger, 1973; Sellitz et. al., 1976; Wiersama, 1980), in this case a mixed mode was used. This facilitated data collection. Factual information such as family income was asked via forced choice questions; whereas, questions pertaining to such things as attitudes, and aspirations were probed through open ended inquiries. In many instances open ended probes follow forced choice questions in an effort to add clarity and gain more insight into the reason behind a given answer.

The interview schedule ultimately consisted of 140 items bearing directly on the factors described herein. Some of the forced choice questions had more than four possible response options. Index cards with the question and the possible responses were printed for these items. These cards were looked at by the respondent while the interviewer read the question and possible answers.

The Interviewers

Interviewers were recruited in two ways. Job announcements were sent to the career and job placement offices of local colleges and universities, as well as the St. Louis Urban League. Second, persons who had served as interviewers for previous research conducted at the Institute of Black Studies were contacted. A total of 19 persons interviewed the students in this sample. As noted earlier in this chapter, this study was part of a larger research project thus the interviewers were interviewing many other persons besides the students upon which this report is based. Most of the interviewers were college graduates who were either looking for full time employment or were currently employed but wished to earn additional income. The one interviewer who was not a college graduate proved to be as capable as the others.

Interviewers were selected on the basis of their communication skills, ability to establish rapport quickly, general ability to grasp the nature of the project and references from former employers. As part of the selection process, each prospective interviewer was asked to interview the investigator using the schedule and related materials. This was done to verify oral reading skills and the ability of the candidate to understand and accurately record the responses to the various questions.

Each interviewer was paid a flat rate of $12 per interview. No allowance was paid for mileage or other expenses. Most interviewers expressed the fact that given the amount of time it took to arrange an interview, travel to and from it, as well as conduct the interview $12 was almost an honorarium. When asked why they continued given the level of compensation, they typically responded that they thought being part of a research project about the education of Black people was an important contribution to the Black community.

Once the interviewers were selected, a training session was scheduled. This took place on a Saturday and was three hours in duration. The training content included an introduction to the project, a review of the interview materials and related procedures, an introduction to effective communication skills, and practice interviews followed by a question and answer session. The interviewers were not told the specific purpose of the research. It was described generally as a study about the curricular and extracurricular math experiences and interests of Black Americans.

The Interviews

Each interviewer was assigned students to contact. There was no predetermined criteria for matching interviewers with students; this occurred by chance. After contact was made and a mutually agreeable time and date were arranged the interview took place. The interviews were conducted in the homes of the students.

The average session took 86 minutes. Again, it should be noted that this study was part of a larger research project; therefore, two other instruments measuring variables not utilized in this study were also completed by the student. These instruments took approximately 20 minutes to complete. The interview consisted of three phases. In the first phase the interviewer introduced him or herself to the student and the student's parents or guardian. These persons were shown the forms which were to be administered. They were also advised of their rights (see appendix E & F, Consent Forms), as well as the responsibilities of the Institute of Black Studies (see appendix D, Research Safeguard Statement). Once the parent (or guardian) and the student signed the consent form the parent was tactfully given the opportunity to leave the room.

During the second phase the student was asked to complete two brief, fixed response, questionnaires. Neither of these instruments assessed academic preferences, math attitudes or other factors as discussed in this report. Upon completion of these instruments the interviewer began the formal interview.

After the interview was finished, the students were asked to complete an interview voucher. This form (see appendix H, Voucher) served as the formal document which the interviewer used to request payment. While the student was filling out the voucher the interviewer completed the Interviewer's Remarks form (appendix G, Interviewers Remarks). The last or third phase of the interview consisted of the interviewer thanking the student and his/her parents/guardians for their participation. The interviewer also left the investigator's business card in the event they wished to make further inquiries about this research.

All interviews were verified by contacting the student or parent by telephone and confirming that the interview did in fact take place.

CHAPTER 3

RESULTS

Introduction

In this chapter the raw findings are reported and discussed so that a composite picture of the student respondents as a group can be ascertained. This permits a contextual understanding of the choices made by the different sub groups of students. The raw findings are organized according to factors. The students are first described demographically, according to age, gender, family income and parental characteristics. Following the demographics are the findings related to the personal factors: attitudes toward math and post high school aspirations. Subsequent to these personal factors, interpersonal factors: parental characteristics and influential others, are described for the overall group.

In line with the question of possible differences related to quantitative orientation and gender, a description of the differences between and within sub groups follows. In this section, the interpretations are based on crosstabulations and chi square analysis. As with the preceeding sections factors are treated as distinct elements, so as to highlight the apparent contribution or lack of same to a given sub group pattern.

In chapter 4, the findings are discussed in a more integrated fashion so as to portray the relationships between factors for each sub group. Typical quantitatively oriented and non quantitatively oriented students are hypothesized based on the descriptive and statistical findings, as well as the respective interpretations. These hypothetical students form the basis of suggestions for future research directions. These profiles also have implications for intervention strategies.

Overall Characteristics

Demographic Characteristics. Divided almost equally by gender, the sample included 28 females (56%) and 22 males (44%). Ranging in age from 16 to 19 with an average age of 18 years, the group reflects the age of typical high school students. Most of the students were born and raised in the St. Louis metropolitan area. Only one student had resided in the area less than twelve years. This student was originally from Chicago, but had lived in the target area for five years.

While all the students lived in the suburbs at the time this research was conducted, only 11 or 22% indicated that they were raised in the suburbs. Given this response I wondered if there was a substantial amount of recent migration. There was not; 96% of the students had attended the same high school throughout their secondary education

(9th-12th grade). Of the two who did transfer, one had attended the then current high school two years and the other three years.

As noted in Chapter 2, 76% reported being raised in an area that was either racially mixed; that is, equal portions of Black and white persons, or predominantly Black (75% or greater Black). Since the Black population of the city is approximately 47% and that of the suburbs is 10.9% it may be assumed that the students are referencing their neighborhoods or center of activity.

Parental Characteristics. The students' families represent a relatively affluent segment of the overall Black American population. Most (84%) own their homes and based on the responses of 37 of the students it is fair to say that the median income was about $22,000. In comparison, the median income in 1980 for Black families living outside the central city, but within metropolitan areas of 1,000,000 or more, was $18,246 (Williams, 1983). Fifty-eight percent of the students lived with both of their biological parents; an additional 16% lived with two parents one of which was a stepfather.

Both mothers and fathers were likely to have been born in the St. Louis metropolitan area (59% and 54% respectively). Twenty-eight percent of the fathers and 38% of the mothers were born in southern states; principally, Arkansas, Tennessee and Mississippi. The other parents were from the states of New York, New Jersey, California and Kansas.

Thirty-eight percent of the fathers were employed in white collar occupations; 18% were classified as professionals, technical and kindred (teachers, nurses, engineers) workers, 14% fell into the managers and administrators category and 6% were categorized as clerical. The dominant spheres were manufactoring and government. Forty-two percent were blue collar workers; employed primarily as operatives (20%), in the crafts (14%), as laborers (4%) or in service occupations(4%). The mothers were to a greater extent employed in white collar positions (50%); eighteen percent were employed in professional, technical and kindred occupations, 4% as managers or administrators and 18% in clerical or sales positions. The dominant spheres were education, manufacturing, and health. Twenty-two percent of the mothers were employed in blue collar occupations; 10% as operatives, 8% in laborers and service positions, and 4% in the crafts.

By comparison, in 1980 23.8% of all Black American males were employed in white collar professions; 56.3% in blue collar occupations. Approximately 49% of all Black American women workers were employed in white collar occupations while 18.5% were employed as blue collar workers (Williams,1983). These percentages are based on 1980 U.S. Census data.

As would be expected given the income and occupational distribution of this group, the students' parents were fairly well educated. Twenty-five of the mothers and eighteen of the fathers had a minimum of a high school education. An additional 23 mothers and 18 fathers had one to three years of college. Five mothers and two fathers had finished college and had obtained graduate degrees.

In comparison with all Black men and women 25 years and over, these parents were also educationally atypical. According to 1980 census data, 32% and 31.1% of Black women and men respectively had completed college; only 20% of Black women and 19% of Black men had attended college 1-4 years (Williams, 1983).

Consistent with the middle class flavor of the group, as well as the high aspirations Black parents tend to have for their children in general (Billingsley, 1968; Scanzoni, 1971), many parents were thought to favor white collar (professional, technical, managers, etc) occupations for their children. Of the 17 students who said their mothers had occupational preferences for them 12 named medicine. Another four said their mothers wanted them to pursue a technological occupation such as engineering. The remaining student's mother preferred a legal career. Fathers on the other hand, while having different occupations in mind were--according to 38 students (76%)--also hoping their children would pursue white collar careers. The fathers' occupational preferences for their offspring were fairly evenly distributed among the areas of technology, medicine, business, broadcasting and psychology. Three fathers hoped their children would be professional athletes or musicians.

Perhaps the most striking aspect of parental occupational preference is the low number of students who said their parents had a preference. Fifty percent of the students said their mother, and 46% said their father had no occupational preference for them. Another seven said they did not know if their mother had an occupational preference while nine students didn't know if their father had a preference. This response pattern is, on the one hand, surprising because as is discussed in detail later, parents are very influential persons in the minds of most students. On the other hand, it is consistent with the findings of Scanzoni (1971); many Black parents are supportive of their children's occupational aspirations and do not push their own biases.

Attitudes Toward Math. This factor was, as discussed in Chapter 2, defined in two ways. On the one hand, it was conceptualized as a student's remembered thoughts and feelings while in a mathematical problem solving setting. Secondly, it was defined in terms of usefulness or value in the opinion of the students.

In order to obtain information on the first aspect of math attitudes 14 questions were asked. These are as follows:

Item Number	Item
89	What are your favorite high school subjects?
90	Of these, what subject do you like the most?
90A	Why was____your favorite subject?
91	Please rank your favorite subject in order of preference.
92	What subjects do you like the least in high school?
93	Of these, what subject do you dislike most?
93A	Why is ___ your least favorite ?
94	Please rank the subjects you dislike most.
96	Do you think the grades you earned in math were, in general, an accurate reflection of your mathematical ability?
96A	Why/why not?
101	In comparison with other students in your high school math classes would you say you were more, as, less capable than other students when it came to solving math problems?
111	Of the following descriptions which would you say comes closest to describing how you felt about the last math class you had in high school? (interesting, challenging, enjoyable, boring, intimidating, frustrating)
111A	Please explain why you feel this way?
112	Think back to the last high school math class you had. Of the following descriptions which one(s) characterize the math teacher for that class? (really liked/disliked math; made/did not make math exciting; was/was not enthusiastic)

The students were first asked to list in no particular order their favorite subjects. This question was used to begin directing the student to reflect on high school classes and subjects. More students responded by first naming humanities courses as among their favorite than any other subject area. Of the three most frequently noted, humanities was indicated by 42 (84%) students. Math was listed by 26 (52%) and the physical sciences by 25 or 50%.

However, when students were asked to name the one subject they liked the most, math ranked number one while humanities ranked number three. Accordingly, fourteen or 28% of the sample named math as their favorite subject. Another nine or 18% named the physical sciences; while eight or 16% named the humanities. The other 18% mentioned a variety of subjects like physical education, dance and other performing arts, and industrial arts.

The students were then asked to explain why a given subject was liked the most. Twenty-eight percent said the course content was the reason; of this group of 14, nine said the subject was interesting or fun. Twelve percent, or six students, said their ability to learn the subject matter was their reason for liking it best. Sixteen percent (8) of the students said their favorite subject was related to their career aspirations. The other 27 students did not explain why they liked a particular subject best.

Of particular interest are the comments by students who named math their favorite subject. The following are representative comments from three females and three males:

female	"I like working with numbers"
female	"Because I can do it the best of all subjects"
female	"I was challenged to think in math courses"
male	"I never minded doing and solving math problems"
male	"It seemed to be the only class that changed from year to year"
male	"It was something I really paid attention to...something I really liked."

The students were asked to rank their favorite subjects. Again math ranked number one, followed by the humanities, then the physical sciences. A total of 24 or 48% of the sample ranked math their first or second favorite subject. Humanities on the other hand was also listed as the first or second preferred course by 48% of the students. The physical sciences were ranked first or second most favorite by a total of seventeen or 34 percent of the sample.

While 48% of the sample liked math best of all their subjects, 20% or 10 students liked it least of all their subjects. Surprisingly, for the researcher at least, thirty-four percent or 17 students named humanities as their least liked subject. Sixteen percent of the students named the physical sciences as least liked.

The reasons students gave for disliking a given subject are categorically similar to those given for liking a subject. However, in this instance the responses were on the negative end of the continuum. Ten percent indicated they had difficulty grasping the subject matter. While worded in various ways most students (56%) described their least favorite subject as boring. Eight percent disliked the subject matter and 16% didn't like the teachers. Ten percent did not comment.

When asked to rank their least favorite courses humanities was ranked as the most disliked subject by 17 or 34% of the students. Math was named as most disliked by 11 or 22% of the students and the physical sciences were so ranked by 8 or 16% of the students.

A substantial number of the students were involved in extracurricular math activity. Along these lines, students were asked to indicate the extent to which they engaged in the following math activities:

Read articles on math in magazines or newspapers;
Watched television programs which focused on math;
Went to lectures in which the topic was some aspect of math;
Read books on math;
Talked to friends about math;
Did math projects which were not required in math class;
Had math related hobbies;
Solved math puzzles.

Most of the students rarely if ever read articles, looked at television shows or attended lectures focusing on math if these activities were not required for a specific course. This may have been due to lack of interest, or in the case of television or lectures, lack of opportunity. On the other hand, 42% (21) said they read books on math and 60% (30) indicated that they talked to friends about math with regularity. One is tempted to question the latter response. For example, the students may have casually talked with friends in the hallways of school about class assignments as opposed to conversing about various aspects of mathematics without reference to a given class. One cannot however, readily dismiss the fact that ten students (20%) indicated that they did math projects which were not required in math class. Similarly, 20% said their hobbies were often math related and almost one third of the sample solved math puzzles regularly.

For most students their last math class was remembered as challenging (36%), interesting(16%) or enjoyable (14%). In contrast, about a third of the sample remembered it negatively as being boring (12%), intimidating (4%) or frustrating (18%). These findings coupled with comments about why a particular course was favored suggest that these students have, for the most part, a positive inclination toward math as a subject because of its inherently interesting qualities. In particular this is illustrated by two students' comments about math; "...always new" and "I was challenged to think." Incidently, there is no significiant relationship between feelings about last math class and ranking of math as a favorite subject.

How are math teachers remembered? When asked, 90% (45) remembered their last math teacher as really liking math. Sixty-six porcent of the students felt the teacher made the class exciting, and 80% considered the teacher enthusiastic.

Clearly the emerging picture is one of "good vibrations" for math. These students have positive memories of their last math class, and their math teachers. There is even a tendency to engage in mathematical activities for intrinsic reasons or put colloquially--for the fun of it.

Given this rosy picture, it is interesting to see how students value the subject. Put bluntly, what good is it? The value students place on math was assessed through three questions. First, in the context of overall societal advancement; second, in terms of securing a "good paying" job; and third, as it relates to securing employment in a profession or occupation which benefits the Black community. The third index requires a brief explanation.

It has been postulated that western researchers frequently fail to understand the responses of Black Americans because a Euro-centric world view is assumed (Dixon, 1976; Dixon & Lewis, 1968). This world view is thought to be based on competition and the individual good. The Afro-centric world view on the other hand is thought to be based on cooperation and the collective good. Given this theoretical set, one may expect explanations of values or choice of occupations, for example, to be related to the Afro-centric or collective good world view. In other words, a student may see value in mathematics because it is of benefit to the Black community. Similarly, a student may choose a particular career for the same reason. This second point will be discussed later when post high school occupational aspirations are reported.

Most students (78%) considered math no more or less important to the advancement of society than any other subject. Twenty-two percent considered it more important than any other subject. No one thought it less important than other subjects. Sixty percent of the students gave reasons for their ratings. From their explanatory remarks, it seems that many students viewed math as an inherent part of everything one does in life (44%) and an important part of the world of work (16%).

When specifically asked about its value or importance in getting a good paying job, over half the students (58%) said it was very important. Forty-two percent said it was somewhat important and no one considered it unimportant. The students explanatory comments revealed that many students considered it either a necessity for today's increasingly technological job market or felt that the more prestigious and lucrative professions such as medicine and engineering require a good math background. Of those who considered it no more or less important than other subjects, most were fairly unspecific about their reasons. Essentially, these students felt the importance of math depended generally on one's occupational interest or that other subjects were of equal importance.

In terms of its importance for employment in professions benefiting the Black community 40% said it was very important. This contrasts sharply with the 78% who considered it no more or less important to the advancement of society in general than any other subject. In subsequent analysis there proved to be no relationship between a student feeling that it benefits the Black community and it benefits society in general.

We know that math is favored by many of these students. This subject is described as interesting, challenging or enjoyable by sixty-six percent. Some form of extra curricular math activity is engaged in by many of the students. The students remember their last math teacher positively; the teacher was thought, by most students, to have been enthusiastic, to have liked the subject, and to have made the class exciting.

Not only did many of the students like the intrinsic aspects of the subject and remember their last math teacher fondly, they also show an awareness of its value to future employment. There also appears to be a definite sense that occupations which are a benefit to the Black community require good math backgrounds.

All things considered, we might expect a strong tendency toward quantitative orientation. In fact there is...twenty-one or 42% of the students had taken three or more years of college preparatory math classes. The mode was three years. Twenty-nine or 58% of the students had taken less than three years of college preparatory math. In this group, fourteen (28%) took two years, thirteen (26%) took one year and two students (4%) had only taken general math courses.

The fact that fifteen students took one year or less of advanced or college preparatory math coursework does not necessarily mean they had little math in high school. In other words, by counting all math courses taken including such subjects as general math, is there a substantial increase in participation? No there isn't; the number of students taking three or more years of math only increased by 2, for a total of 23.

Educational and Occupational Aspirations. Seventy-four percent of the students planned to attend a four year college or university upon graduation from high school. Sixteen percent or eight students planned to attend a two year or junior college. Four students expected to attend a trade school and one student had not decided what to do upon graduation from high school.

Of the 35 students who gave specific reasons for attending a four year college or university the three most frequently cited reasons were:

TABLE 1

REASONS FOR ATTENDING FOUR YEAR COLLEGE OR UNIVERSITY

Reasons	f	%
To achieve occupational goals	13	26
To continue his or her education	9	18
To conform to parental expectations	8	16
Other	20	40
Total	50	100

The connection between graduating from a college or university and ultimately obtaining financially rewarding employment is not strong as only three students (included in the "other" category) offered this as a reason. Academic counseling or advising on the part of high school counselors is mentioned as frequently as information gleaned from college recruitment literature according to this group (both responses are part of the "other" category also). Three students attribute counselor influence to their decision and three students attribute their image of college life as obtained from college brochures to their decision.

It is also interesting that only thirteen students or twenty-six percent tie their choice of a four year college or university to employment. In contrast, over half or fifty-eight percent of the students previously indicated math was very important to securing a financially rewarding or "good paying" job. Several possibilities come to mind as to why the different pattern of response. First of all, the questions were posed differently. In the case of importance to a financially rewarding job, the question was forced choice. In the second instance students were asked to explain their post high school choice in their own words. Thus, it may be argued that if the second question was forced choice (i.e. Do you feel college is very important, somewhat important, unimportant to securing a good paying job?) similar response patterns may have resulted. It is also possible that they are thinking sequentially; first college than a lucrative career. Or, it may be that many students feel the primary reason for obtaining a higher education is simply to get better educated.

Of the eight students who planned to attend a junior college three gave specific reasons. These students indicated that the training would enhance their employment options. Three of the four students who planned to attend trade school gave specific reasons. Two students had particular trades in mind and the other explained that limited financial resources precluded other options.

All of the students who indicated they planned to attend a four year college or university or two year college upon graduation from high school were asked to state the major subject area or training focus they intended to pursue. Forty of the possible 49 students declared a major or training focus. The breakdown is as follows:

TABLE 2

COLLEGE MAJOR OR TRAINING FOCUS

	f	%
Business	8	20
Technology*	16	40
Math or Science	5	12.5
Liberal Arts	11	27.5
Total	40	100

*i.e. engineering, computer science

To a certain extent the students' major or training foci parallel their perception of math's relationship to employment. However, these findings suggest that at least twenty-nine or 58% of the total sample should, given their educational aspirations, have taken three years of advanced math. Only 42% of the students had done so.

In order to determine possible reasons for this discrepancy the 16 non quantitative students who expressed intent to attend a four year college or university were isolated and a seperate analysis of their responses was performed. Of this group of 16, twelve indicated their prospective majors. Six planned to major in a math or science related subject area. Seven of the the twelve said math was their favorite subject and another student named computer science as his or her favorite subject. There were no discernible differences between these students and their quantitatively oriented counterparts which may be attributed to parental background or aspirations for the student, student occupational aspirations, or gender. In light of these findings, one can only conclude that these students may not have been properly advised of the critical link between their high school math preparation and their post high school aspirations.

It is interesting to see the reasons why students choose certain majors. In the four year college group the explanations fall, by and large, into three categories:

liking for the occupation, financial reward, and a helping orientation toward society.

Just as many of the students liked math for its inherent qualities, a sizeable number (32%) said their training preference was based on a liking for the nature of the related occupation. One student said, "Because I like math and science and I've been exposed to many engineering occupations and found them interesting." Or in the words of another, "I want to design and build housing, office buildings or anything."

Ten students expressed a desire to be employed in an occupation through which they could make a societal contribution as their reason for their choice of college major. One student put it simply, "I like helping people." Another said, this occupation was the best way to help the Black community. This student, by the way, was the only one to specifically reference the Black community in the context of occupational choice.

The benefits of a given occupation (financial rewards, career mobility) was indicated as the basis of their choice of major by nine students. In the words of one student, "Because it is a rapidly growing field." "Pays good money," said another.

Forty-three students (86%) felt they knew what occupation they ultimately wanted to pursue. Sixty-four percent or 32 students expressed interest in professional and technical occupations such as architecture, engineering, medicine, psychology, and accounting. Six of the seven students who were undecided about the occupation they wished to pursue indicated they were considering occupations in the professional and technical category; the other student's response fell into the management and officials category.

TABLE 3

STUDENTS' OCCUPATIONAL ASPIRATIONS

	f	%
Undecided	7	14
Professional & Technical	32	64
Managers & Administrators	4	8
Clerical & Sales	2	4
Operatives	3	6
Service work	2	4
Total	50	100

The students were asked why they chose a particular occupation. Forty two percent of the students said they liked the tasks and responsibilities inherent to the occupation. Sixteen percent felt they could make a societal contribution through this occupation. Another 16% were interested in the occupation because of the salary and the opportunities for professional advancement. The remaining thirteen students were unsure or did not respond.

TABLE 4

STUDENTS' REASONS FOR OCCUPATIONAL CHOICE

	f	%
No Response	6	12
Inherent nature of profession	21	42
Societal Contribution	8	16
Salary and Job Opportunities	8	16
Unsure	7	14
Total	50	100

Thirty-six percent or 18 students felt that math would be used extensively in their profession. For these students it is, in their words, the basis of their chosen occupation. Specifically this meant it was used to solve problems, analyze situations, and make decisions. Another 15 (or 30%) of the students felt its application to be fairly limited in terms of use, but not necessarily in terms of significance. These students mentioned its use in statistical measurement and computation. In other words, it was one of several tools employed in their chosen occupation. Only six students indicated that they were unsure of math applications in their profession. Eleven students (22%) did not answer this question.

Influential Others. As mentioned earlier, it was thought that a student was likely to consult with other people about coursework selections, post high school education, and careers. Who these people were and the extent of their influence from a student's perspective was pursued via nine questions. Three of these were multiple choice and essentially asked the student to indicate which persons (from a list of 15) were very important, important, somewhat important, or not at all important in terms of influencing their math coursework selection, post high school plans and occupational aspirations (see questions 21, 124, 133 on the Interview Schedule). Following each of these three questions there were two follow up questions which asked the students to rank the persons in terms of importance and least importance. All of the actual questions may by found on pages 23,24,32,33,38 and 39 of the Interview Schedule (appendix B).

There were five categories of person most often described as very important in helping the student decide which math courses to take: mother (59%); high school counselor (48%); high school teacher (32%); father (30%) and junior high school counselor (28%). This constellation holds even when controlling for absence of the biological father.

When the ratings "very important" and "important" were combined a striking change results. High school counselors overtake mothers (86% versus 66%) and high school teachers trade places with junior high counselors (40% versus 56% respectively). Fathers retain their position relative to mothers and counselors.

While one often hears parents complain that their children only talk to their peers, the evidence in this case does not support this allegation. Only two students considered their peers very important and twelve students considered them somewhat important in terms of helping them make math coursework decisions.

There were also people whom the average student considered completely unimportant to the math coursework decision process: ministers, older siblings, grandparents, and older relatives.

The data on influential others discussed thus far were based on raw frequencies. However, similar patterns emerged when the students were asked to rank these persons in terms of importance or lack there of. Mothers, senior high school counselors and fathers are ranked as most important in that order. Ministers, grandparents, peers and older friends are ranked as least important.

There was a tendency on the part of the students to discuss post high school plans (college versus trade school for example) with a lot of people. As with math coursework selection, mothers were deemed the most important person in this area of planning (66%). Fathers on the other hand exercise more influence on post high school planning then they did with math coursework selection. They are by absolute frequency for the "very important" category and student ranking, the second most influential person (50%). Following fathers, came high school counselors (38%), high school teachers (26%) and finally older sisters (22%). It should be noted that 44 students had older sisters and 43 had older brothers.

When the students were asked to rank in importance the persons rated as very important, mothers were once again number one by a strong lead. Fathers were second and high school counselors were a distant third. Conversely, the students ranked ministers, grandparents, junior high school teachers and junior high school counselors as the least important person in this choice category.

As with math coursework selection, peers do not play a strong role in influencing post high school plans. However, they should not be dismissed totally as important influential others because they border on being important on this dimension.

The final index on influential person referred to occupational decisions. Forty-four students stated a definite occupation in which they hoped to engage. The remaining six had at least one occupation that they were considering. Again, the number of persons consulted about occupational options was large. Without exception every category of person was consulted by at least a couple of students. However, number and range of consultants aside, mothers were once again the dominant influential persons category (66%), followed by fathers(44%), high school counselors (38%) and finally high school teachers (34%).

In this category the father is consistently second. Hence it appears their influence is greatest when it comes to occupational choices. High school counselors and teachers are also consistently third and fourth in rank both by frequency of mention and when ranked by the students on this index.

The occupational dimension reveals a smaller concentration of important persons and a greater concentration of unimportant persons. Neighbors, college counselors, ministers, and college teachers were the least important. And for the first time peers exert an extremely weak amount of influence.

On this index college counselors and teachers show up in the important category for the first time. Evidently, forty-six students had talked with a college counselor about occupations and forty-five had talked with a college teacher. In spite of this large degree of contact 89% and 91% of the students respectively considered these categories of persons unimportant.

Having reported overall group patterns, we now turn to the sub groups. Only differences significant at the <.05 level or better between groups are reported for the most part. Differences which are between the <.06 and <.09 level are reported when informational clarity is facilitated. The findings are reported by factor as was done in the preceeding section of this chapter. All findings are based on Chi Square analysis. The relevant tables are in the appendix A.

Subgroup Comparisons

Demographics and Parental Characteristics. As found in some previous studies, family income is positively related to quantitative orientation. In this sample, quantitatively oriented (QO) students tend to come from families who have annual incomes of $24,000 or more; non quantitatively oriented students (NQO) are likely to have family incomes of under $24,000 (table 6). Furthermore, this difference is also statistically significant for quantitatively oriented females versus non quantitatively oriented females (table 7). Females from families with incomes greater than $24,000 have higher educational aspirations than their less affluent counterparts (table 8). There was no significant difference between QO males and their NQO counterparts when controlling for income.

While only approaching statistical significance (<.07) there is more of a tendency for the mothers of QO students to have attended college than the mothers of NQO students (table 9). There are no apparent sex differences in this regard. There is no difference between QO and NQO students in terms of fathers attending college. The fathers of QO females are more educated than the fathers of NQO females however (table 10). There is no comparable difference between QO males and NQO males.

The fathers of QO students are more likely to have a specific occupational preference for their offspring than are their NQO counterparts (table 11). It does not however matter what the specific occupational preference is; what seems to be important here is that the father communicates his expectations to his offspring.

Attitudes Toward Math. Quantitatively oriented students do not differ statistically from NQO students in terms of their favorite courses. The two groups do differ from each other in terms of least favorite courses. Quantitatively oriented students show a disinclination toward courses which fall under the humanities or non-math umbrella (table 12). Non quantitatively oriented students, on the other hand, are almost split in their dislike for math versus non-math courses.

Similarly QO females express a distinct dislike for non-math related courses; their NQO counterparts dislike math and science courses the most (table 13). There is no difference between male sub groups on this index.

This pattern prevails to a certain extent, and is also statisically significant, when controlling for occupational preference (table 14). Quantitatively oriented students who have chosen an occupation they'd like to pursue express a strong dislike for the non-math courses. Comparable NQO students show a tendency to dislike math courses more so than non-math or humanities courses.

My analysis of responses to the series of questions concerning extra curricular math activities reveals one difference between QO's and NQO's, as well as, some interesting differences within gender groups. Quantitatively oriented students were more likely to attend extra-curricular math lectures than NQO students (table 15). Quantitatively oriented females differ from their NQO counterparts in two ways. The QO's are more likely to attend lectures on math (table 16), and have hobbies which are math related (table 17). Quantitatively oriented males differ from their NQO counterparts by their likelihood to solve math puzzles (table 18).

Comparisons between males and females controlling for quantitative orientation reveals only one salient difference also. This is the extent to which QO females versus QO males have hobbies which are math related--females are more likely to than males (table 19). This finding is clouded because none of the students listed a hobby that could be classified as math related when asked to name their hobbies via an open ended question posed earlier in the interview.

We might expect to find a strong relationship between how students value math and their coursework election patterns given some of the research cited in Chapter 1. The findings in this study do not support this expectation. There are no significant differences between or within groups in terms of math's importance to the advancement of society in general or obtaining a financially rewarding job.

There is however a relationship between quantitative orientation and value to the Black community (table 20), as well as between gender and value to the Black community (table 21). Quantitatively oriented students tend to devalue the importance of math to the Black community rating it only somewhat important for the most part. The NQO's however, are split; a little more than half rate math as very important--the others as somewhat important--and in rare instances as unimportant. The girls do rate it significantly more important to the advancement of the Black community than do boys. An analyis of their open ended comments suggest that girls feel the Black community in particular needs people who work in occupations which are based on math (i.e. engineers). In contrast but, only approaching statistical significance (<.06) boys feel that math education is more important to society in general than girls (table 22). Similarly, NQO boys feel math related occupations are more important to the Black community than do QO boys (table 23).

Aspirations. Upon graduation from high school all of the quantitatively oriented students plan to attend a four year college or university. The NQO's on the other hand are as likely to attend a two year college or trade school as they are to attend a four year institution (table 24). Similarly, QO females differ from NQO females (table 25). Although not conclusive, there is evidence from the students' comments, and the difference between girls associated with income, that the choice of a junior college or trade school may be linked to financial limitations.

As might be expected given their strong tendency to plan to attend a four year college or university, QO's virtually without exception want to be employed in white collar occupations (table 26). Whereas, NQO's list blue collar as well as white collar occupational preferences.

Girls and boys do not differ by occupational aspirations. Nor do they differ in the statistically significant sense in their reasons for choosing a given occupation (<.10). However, girls do indicate a disire to help people (34.8%) as the basis for occupational choice and boys never give this as a reason. Boys are more likely to be attracted to an occupation because of the responsibilities or tasks inherent to it (table 27). There are no salient differences in this regard between QO's and NQO's.

Influential Others. Parents, high school counselors and teacher, and to a lesser extent junior high counselors and sisters were considered the most influential persons according to the students as a whole. The degree to which the influence of these persons is related to quantitative orientation is not evident. These key influential persons tend to influence everyone to the same extent.

In terms of educational aspirations, NQO's are more influenced by their older brothers than are QO's although this difference only approaches significance at the <.06 level (table 28). Older brothers are statistically more influential with their younger NQO brothers than NQO sisters (table 29). The influence of fathers on post high school educational plans is most important among QO females than any other group (tables 30 and 31). Boys, irrespective of their quantitative orientation are divided. They are as likely to consider their fathers important as they are to consider them unimportant.

CHAPTER 4

DISCUSSION

The fifty students who participated in this study have provided us with a better understanding of what facilitates the election of advanced mathematics and what does not. From their comments a picture begins to emerge which permits the formulation of more precise research and relevant intervention strategies.

The quantitatively oriented student appears to be one who is from a relatively affluent family. He or she is likely to have a mother who has a college degree and a father who has expressed high occupational aspirations for his offspring. Furthermore, if the student is female, her father, as well as her mother, is likely to have attended college. Her father also plays a strong role in helping her determine her post high school educational plans.

A clear preference for mathematical courses as opposed to such subjects as English, history and social science is characteristic of the quantitatively oriented student. This student enjoys the non-repetitive and challenging aspects of math. Courses which are not mathematical in nature seem boring and redundant. The non quantitatively oriented student is more flexible along this dimension. This student is as likely to be attracted to and enjoy courses which fall under the humanities umbrella, as much as, those which involve or center on mathematics. The distinction in coursework preferences is particularly pronounced when comparing a typical QO female with a NQO female. In this case the two fall at opposite ends; the former dislikes non math courses and the latter dislikes math courses.

The typical high school student is likely to have at least one hobby or extra curricular pursuit. In this respect, a quantitatively oriented student is more likely to attend lectures, the topic of which is math, than a non quantitatively oriented student. This characteristic is very pronounced among female students. Additionally, a QO female is very likely to have a hobby which she feels is math related. As pointed out earlier it is difficult to get a handle on this because the students do not list hobbies which are readily classifiable as math related. A male student, irrespective of quantitative orientation, and a NQO female are not likely to have similar interests. A quantitatively oriented male is, however, more apt to solve math puzzles during leisure time than his NQO or female counterparts.

Math is viewed as no more or less important than any other subjects to societal advancement or the Black community in the opinion of a quantitatively oriented student. Furthermore, its value to securing employment with a high salary is known, but this does not in and of itself foster quantitative orientation. A non quantitatively oriented student, on the other hand, attaches importance to math in terms of its benefit to the Black community. While it is not altogether clear why this opinion is held, the basis seems to be threefold. First, that the Black community's problems are economic in nature hence a math background enables one to understand business practices or manage a business. Secondly, knowledge of math is considered important for understanding the economic implications of social policy. Its use as a tool for contributing to theories or information which are of concern to Black Americans was the third type of explanation.

Our quantitatively oriented student is definitely college or university bound. This student is unlikely to be interested in attending a trade school or junior college. He or she aspires to a white collar occupation, such as that of doctor, lawyer, psychologist, architect or engineer, which tends to be prestigious if not lucrative. Our non quantitatively oriented student is somewhat likely to opt for a two year degree or trade school certification that involves a specific vocational curriculum such as nursing, technical drafting, or one of the building crafts. However, it should be recalled that among the NQO's there is still a strong tendency toward professional aspirations.

Aside from the aforementioned differences between the typical quantitatively oriented student versus the typical non quantitatively oriented student, there are numerous and important similarities. Parents, high school counselors, and high school teachers are all very influential in helping a student make important decisions. Since mothers are by far the most important group of influencers it is reasonable to hypothesize that the extent to which they are educated on the importance of math the more likely we are to see students enrolling in advanced math electives. The same holds true for fathers, but there is a twist. NQO males seem to be greatly influenced by their older brothers and to a lesser extent by their fathers. Since the reverse is true for QO females, fathers should be targeted by school officials as an important source of curricular and career guidance for their male as well as female children.

Counselors and high school teachers are very important sources of information and serve as consultants to all students irrespective of the student's quantitative orientation or gender or socioeconomic status. An unfortunate limitation of this study is that there are no clues as to the specific nature of their counsel and its import to the main question at hand. It would be helpful to know for example, whether there is differential tracking depending on income or family background or the results of standardized tests or gender for that matter.

It is very clear that even if students like math, and their math teacher, participation in advanced math electives will not automatically result. Even positive experiences in math classes coupled with high educational and occupational aspirations is not necessarily enough. Most illustrative of this point are the 16 MQO students who plan to attend a four year college or university upon graduation from high school. Their parents' educational and occupational expectations of them were consistently high. Twelve of these students knew the subject area in which they planned to major. Six said they would major in a math or science related area; five planned to major in the social sciences; and one planned to major in business. Furthermore, the six who planned on math or science related majors also named math as their favorite subjects. In spite of all this they took less than three years of math. The implication of this finding is that concrete information about the significance of high school math preparation to college majors and ultimate career aspirations is a crucial link.

It appears that lower income students do not aspire to the same heights as their more affluent counterparts for two reasons. First of all, their awareness of career opportunities is not as great. Secondly, lack of money and lack of information about financial assistance may prevent them from believing that attendence at a four year college or university is a realistic goal. And if this is not considered a possibility then a profession for which this educational background is a prerequisite is clearly out of the question. Assuming this is indeed the case, counselors and teachers must develop ways to expose these students to the many career options. Secondly, they must make more information on sources of financial assistance available.

Obviously, every student should not feel compelled to attend a four year college or university. Similarly, all students should not be encouraged to pursue technical or white collar professions. The point is, every student should be fully informed about the implications for his or her educational and occupational future before choices are made which in effect limit their options. In order to make this possible counselors and other educators must be well informed and have the opportunity to share this information throughout a student's formative years. Second, parents should be made cohorts in the advising and career orientation process. For example, workshops for parents might be designed, the contents of which should include a review of the available math electives; a discussion of the relationship between math coursework to college admissions requirements, as well as college majors and career options; and sources of financial assistance for college.

Educators must insist that school districts evaluate, and where appropriate, modify the mathematics coursework requirements for secondary schools. The fact that many students enjoy math must be capitalized upon so that more students, irrespective of socioeconomic status or parental background are eligible to attend a four year college and major in mathematical, business, scientific and technological subject areas. Those undergraduates who desire degrees in other disciplines would also benefit; they would be more mathematically literate and hence have greater career flexibility within their occupations.

It is difficult to compare the findings of this study with the related research. This study was not designed to replicate any other research findings, but rather to provide an integrated and coherent assessment of the problem. There are some areas of agreement and disagreement worth highlighting however.

First of all, in this study family background, specifically socioeconomic status and parental educational attainment, does make a difference as suggested by Bond (1972) and Bell (1974). Padula (1974) and Young (1974) would not agree given the conclusions of their research. Because of the differences in sampling techniques, sample characteristics and size these studies represent it is not possible to explain completely the contradiction posed by this factor. It may be that general achievement, and academic achievement in schools are associated with socioeconomic status favoring the relatively affluent, whereas professional scientific attainment requires other qualities that are a bit more democratic in nature such as persistence. In other words, there are people who transcend the obstacles often associated with limited financial resources and achieve tremendous occupational successes in the sciences as well as other endeavors. These people evidently possess qualities which in effect offset obstacles and facilitate achievment.

Quantitatively oriented students have had positive experiences with math and in this respect they may be comparable to Young's (1974) Black scientists. The QO's and the NQO's who have positive attitudes toward math, when compared with the junior high school sample in Johnson's (note 5) study and the high school students in the Marrett and Gates (note 1) study, lead me to speculate that many youngsters like math and if given encouragement will continue to pursue this area of coursework.

While there is a definite tendency for non Black females to avoid high school mathematics coursework (Fennema and Sherman, 1977; Sells, 1972; Ernest 1979) there is no evidence from this study that this is true of Black females. Similarly, there is no support for the Marrett and Gates (note 1) finding that Black girls are more likely than Black boys to enroll in advanced math courses.

In spite of the fact that there are relatively few Black Americans employed in mathematical, scientific and related professions, there is no evidence that this would also be the case with this sample. This raises the possibility that these kinds of aspirations are modified or negated at the undergraduate level. On the other hand, it is quite possible that this group of students are better counselled than the larger Black student population and will achieve their goals.

In contrast with Jacobowitz (1980) no evidence is provided for the finding that Black females are generally not interested in scientific careers. What is apparent is that girls are attracted to occupations through which a societal contribution can be made. Hence, the degree to which mathematics and scientific occupations are shown to benefit or help others is an important element in maintaining or motivating female interest in quantitative occupations.

A Final Note

In the course of conducting this study and analyzing the resultant data I have concluded that further research is sorely needed. First and foremeost, a comparable study involving a larger group of students that is more representative of Black American high school students as a whole is still needed. This would permit generalizations to the larger population and possibly the identification of additional distinguishing characteristics. This is particularly important if we are to understand the differences within gender groups. We must recall that eight differences between QO and NQO girls were found, while only two differences were found for boys. Of course we could assume boys are more homogeneous as a group, but without a larger sample that is more representative of Black high school students as a whole this would be a fallacious conclusion. The relatively small number of boys involved in this study weakened my ability to investigate similarities and differences. This was especially true when relatively large numbers of boys failed to respond to a question.

Information about the nature of advice given by influential others merits more extensive examination also. This will result in specific recommendations on how to structure parental involvement, as well as career and academic counseling. Finally, the qualities of a math class and teacher which combine to make for an enjoyable or challenging versus boring or intimidating experience need to be explored in a way that better permits a student to describe this phenomenon in his or her own words. This information will allow math educators to refine those aspects of the classroom environment that foster positive attitudes and modify those that serve as hindrances.

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APPENDICES

APPENDIX A

TABLES

TABLE 5

COMPARISON OF NON QUANTITATIVELY ORIENTED (NQO) AND QUANTITATIVELY ORIENTED (QO) STUDENTS BY GENDER

	GENDER		
ORIENTATION	FEMALE	MALE	ROW TOTAL
NQO	16	13	29
QO	12	9	21
COLUMN TOTAL	28	22	50

CORRECTED CHI SQUARE=0.0

WITH 1 DEGREE OF FREEDOM

SIGNIFICANCE=<1.000

TABLE 6

COMPARISON OF NON QUANTITATIVELY ORIENTED (NQO) STUDENTS AND QUANTITATIVELY ORIENTED (QO) STUDENTS BY FAMILY INCOME

	FAMILY INCOME		
ORIENTATION	<$24,000	>$24,000	ROW TOTALS
NQO	13	5	18
QO	4	15	19
COLUMN TOTAL	17	20	37

CORRECTED CHI SQUARE=5.727

WITH 1 DEGREE OF FREEDOM

SIGNIFICANCE=<.01

TABLE 7

COMPARISON OF QUANTITATIVELY ORIENTED FEMALE (QO) STUDENTS AND NON QUANTITATIVELY ORIENTED FEMALE (NQO) STUDENTS BY FAMILY INCOME

	FAMILY	INCOME	
ORIENTATION	<$24,000	>$24,000	ROW TOTALS
NQO	9	1	10
QO	1	10	11
COLUMN TOTAL	10	11	21

CORRECTED CHI SQUARE=10.694

WITH 1 DEGREE OF FREEDOM

SIGNIFICANCE=<.001

TABLE 8

COMPARISON OF GIRLS FROM FAMILIES WITH INCOMES OF LESS THAN $24,000 AND GIRLS FROM FAMILIES WITH INCOMES GREATER THAN $24,000 BY EDUCATIONAL ASPIRATIONS

	FAMILY INCOME		
ASPIRATION	<$24,000	>$24,000	ROW TOTAL
FOUR YR. COLLEGE	5	11	16
JR. COLLEGE	5	0	5
COLUMN TOTAL	10	11	21

CORRECTED CHI SQUARE=4.725

WITH 1 DEGREE OF FREEDOM

SIGNIFICANCE=<.02

TABLE 9

COMPARISON OF NON QUANTITATIVELY ORIENTED (NQO) STUDENTS AND QUANTITATIVELY ORIENTED (QO) STUDENTS WHOSE MOTHERS ATTENDED COLLEGE

	MOTHER ATTENDED COLLEGE		
ORIENTATION	YES	NO	ROW TOTAL
NQO	10	17	27
QO	13	6	19
COLUMN TOTAL	23	23	46

CORRECTED CHI SQUARE=3.228

WITH 1 DEGREE OF FREEDOM

SIGNIFICANCE=<.07

TABLE 10

COMPARISON OF NON QUANTITATIVELY ORIENTED (NQO) AND QUANTITATIVELY ORIENTED (QO) STUDENTS WHOSE FATHERS ATTENDED COLLEGE

	FATHER ATTENDED COLLEGE		
ORIENTATION	YES	NO	ROW TOTAL
NQO	2	11	13
QO	7	4	11
COLUMN TOTAL	9	15	24

CORRECTED CHI SQUARE=4.039

WITH 1 DEGREE OF FREEDOM

SIGNIFICANCE=<.04

TABLE 11

COMPARISON OF NON QUANTITATIVELY ORIENTED (NQO) AND QUANTITATIVELY ORIENTED (QO) STUDENTS WHOSE FATHERS HAVE OCCUPATIONAL PREFERENCES FOR THEM

	FATHER HAS PREFERENCE				
ORIENTATION	YES	NO	DON'T KNOW	OTHER	ROW TOTAL
NQO	5	13	8	2	28
QO	10	10	1	0	21
COLUMN TOTAL	15	23	9	2	49

CHI SQUARE=8.67

WITH 3 DEGREES OF FREEDOM

SIGNIFICANCE=.<03

TABLE 12

COMPARISON OF NON QUANTITATIVELY ORIENTED (NQO) AND QUANTITATIVELY ORIENTED (QO) STUDENTS BY LEAST FAVORITE SUBJECT

	LEAST FAVORITE SUBJECT		
ORIENTATION	MATH/SCI	HUMANITIES*	ROW TOTAL
NQO	14	12	26
QO	4	17	21
COLUMN TOTAL	18	29	47

CORRECTED CHI SQUARE=4.571

WITH 1 DEGREE OF FREEDOM

SIGNIFICANCE=<.03

*I.E. ENGLISH, SOCIAL STUDIES, HISTORY

TABLE 13

COMPARISON OF NON QUANTITATIVELY ORIENTED (NQO) AND QUANTITATIVELY ORIENTED STUDENTS (QO) WHO HAVE OCCUPATIONAL PREFERENCES BY LEAST LIKED SUBJECT

	LEAST LIKED SUBJECT		
ORIENTATION	MATH/SCI	HUMANITIES*	ROW TOTAL
NQO	13	8	21
QO	4	16	20
COLUMN TOTAL	17	24	41

CORRECTED CHI SQUARE=5.785

WITH 1 DEGREE OF FREEDOM

SIGNIFICANCE=<.01

*I.E. ENGLISH, SOCIAL STUDIES, HISTORY

TABLE 14

COMPARISON OF NON QUANTITATIVELY ORIENTED FEMALE (NQO) AND QUANTITATIVELY ORIENTED FEMALE STUDENTS (QO) BY LEAST LIKED SUBJECT

	LEAST LIKED SUBJECT		
ORIENTATION	MATH/SCI	HUMANITIES*	ROW TOTAL
NQO	8	6	14
QO	1	11	12
COLUMN TOTAL	9	17	26

CORRECTED CHI SQUARE=4.815

WITH 1 DEGREE OF FREEDOM

SIGNIFICANCE=<.02

*I.E. ENGLISH, SOCIAL STUDIES, HISTORY

TABLE 15

COMPARISON OF NON QUANTITATIVELY ORIENTED (NQO) AND QUANTITATIVELY ORIENTED STUDENTS BY ATTENDENCE AT MATH LECTURES

	ATTENDENCE AT MATH LECTURES		
ORIENTATION	NEVER	OFTEN	ROW TOTAL
NQO	20	9	29
QO	5	16	21
COLUMN TOTAL	25	25	50

CORRECTED CHI SQUARE=8.210

WITH 1 DEGREE OF FREEDOM

SIGNIFICANCE=<.004

TABLE 16

COMPARISON OF NON QUANTITATIVELY ORIENTED (NQO) FEMALES AND QUANTITATIVELY ORIENTED (QO) FEMALES BY ATTENDENCE AT MATH LECTURES

	ATTENDENCE AT MATH LECTURES		
ORIENTATION	NEVER	OFTEN	ROW TOTAL
NQO	11	5	16
QO	2	10	12
COLUMN TOTAL	13	15	28

CORRECTED CHI SQUARE=5.531

WITH 1 DEGREE OF FREEDOM

SIGNIFICANCE=<.01

TABLE 17

COMPARISON OF NON QUANTITATIVELY ORIENTED (NQO) FEMALES AND QUANTITATIVELY ORIENTED (QO) FEMALES BY MATH HOBBIES

	MATH HOBBIES		
ORIENTATION	NEVER HAVE	OFTEN HAVE	ROW TOTAL
NQO	11	5	16
QO	3	9	12
COLUMN TOTAL	14	14	28

CORRECTED CHI SQUARE=3.645

WITH 1 DEGREE OF FREEDOM

SIGNIFICANCE=<.05

TABLE 18

COMPARISON OF NON QUANTITATIVELY ORIENTED (NQO) MALES AND QUANTITATIVELY ORIENTED (QO) MALES BY FREQUENCY OF SOLVING MATH PUZZLES

	SOLVE MATH PUZZLES		
ORIENTATION	NEVER	OFTEN	ROW TOTAL
NQO	9	4	13
QO	1	8	9
COLUMN TOTAL	10	12	22

CORRECTED CHI SQUARE=5.091

WITH 1 DEGREE OF FREEDOM

SIGNIFICANCE=<.02

TABLE 19

COMPARISON OF QUANTITATIVELY ORIENTED FEMALES AND MALES BY FREQUENCY OF HAVING MATH RELATED HOBBIES

	MATH RELATED HOBBIES		
GENDER	NEVER	OFTEN	ROW TOTAL
FEMALE	3	9	12
MALE	8	1	9
COLUMN TOTAL	11	10	21

CORRECTED CHI SQUARE=4.286

WITH 1 DEGREE OF FREEDOM

SIGNIFICANCE=<.01

TABLE 20

COMPARISON OF NON QUANTITATIVELY ORIENTED (NQO) STUDENTS AND QUANTITATIVELY ORIENTED (QO) STUDENTS BY RATING OF IMPORTANCE OF MATH RELATED OCCUPATIONS TO THE BLACK COMMUNITY

	IMPORTANCE OF MATH RELATED OCCUPATIONS			
ORIENTATION	VERY IMP.	SOMEWHAT IMP.	UNIMPORTANT	ROW TOTAL
NQO	15	12	2	29
QO	5	16	0	21
COLUMN TOTAL	20	28	2	50

CHI SQUARE=6.456

WITH 2 DEGREES OF FREEDOM

SIGNIFICANCE=<.03

TABLE 21

COMPARISON OF FEMALES AND MALES BY RATING OF THE IMPORTANCE OF MATH RELATED OCCUPATIONS TO THE BLACK COMMUNITY

	IMPORTANCE OF MATH RELATED OCCUPATIONS			
GENDER	VERY IMP.	SOMEWHAT IMP.	UNIMPORTANT	ROW TOTAL
FEMALE	15	13	0	28
MALE	5	15	2	22
COLUMN TOTAL	20	28	2	50

CHI SQUARE=6.516

WITH 2 DEGREES OF FREEDOM

SIGNIFICANCE=<.03

TABLE 22

COMPARISON OF FEMALES AND MALES BY RATING OF IMPORTANCE OF MATH TO SOCIETY

	IMPORTANCE OF MATH TO SOCIETY		
GENDER	MORE IMP.	AS IMP.	ROW TOTAL
FEMALE	3	25	28
MALE	8	14	22
COLUMN TOTAL	11	39	50

CORRECTED CHI SQUARE=3.346

WITH 1 DEGREE OF FREEDOM

SIGNIFICANCE=<.06

TABLE 23

COMPARISON OF NON QUANTITATIVELY ORIENTED (NQO) MALES AND QUANTITATIVELY ORIENTED (QO) MALES BY RATING OF MATH RELATED OCCUPATIONS IMPORTANCE TO THE BLACK COMMUNITY

	IMPORTANCE OF MATH TO THE BLACK COMMUNITY			
ORIENTATION	VERY IMP.	SOMEWHAT IMP.	UNIMPORTANT	ROW TOTAL
NQO	5	6	2	13
QO	0	9	0	9
COLUMN TOTAL	5	15	2	22

CHI SQUARE=7.107

WITH 2 DEGREES OF FREEDOM

SIGNIFICANCE=<.02

TABLE 24

COMPARISON OF NON QUANTITATIVELY ORIENTED (NQO) STUDENTS AND QUANTITATIVELY ORIENTED (QO) STUDENTS BY POST HIGH SCHOOL EDUCATIONAL ASPIRATIONS

	POST HIGH SCHOOL EDUCATIONAL ASPIRATIONS			
ORIENTATION	COLLEGE	JUNIOR COLL.	DON'T KNOW	ROW TOTAL
NQO	16	12	1	29
QO	21	0	0	21
COLUMN TOTAL	37	12	1	50

CHI SQUARE=12.721

WITH 2 DEGREES OF FREEDOM

SIGNIFICANCE=<.001

TABLE 25

COMPARISON OF NON QUANTITATIVELY ORIENTED (NQO) FEMALES AND QUANTITATIVELY ORIENTED (QO) FEMALES BY POST HIGH SCHOOL EDUCATIONAL ASPIRATIONS

	POST HIGH SCHOOL EDUCATIONAL ASPIRATIONS		
ORIENTATION	COLLEGE	JUNIOR COLLEGE	ROW TOTAL
NQO	8	8	16
QO	12	8	20
COLUMN TOTAL	20	16	36

CORRECTED CHI SQUARE=6.128

WITH 1 DEGREE OF FREEDOM

SIGNIFICANCE=<.01

TABLE 26

COMPARISON OF NON QUANTITATIVELY ORIENTED (NQO) STUDENTS AND QUANTITATIVELY ORIENTED STUDENTS (QO) BY CATEGORY OF OCCUPATIONAL ASPIRATIONS

	OCCUPATIONAL CATEGORY			
ORIENTATION	NO RESPONSE	PROFESS.& TECHNICAL	NON PROFESS. & TECHNICAL	ROW TOTAL
NQO	5	16	8	29
QO	1	20	0	21
COLUMN TOTAL	6	36	8	50

CHI SQUARE=10.089

WITH 2 DEGREES OF FREEDOM

SIGNIFICANCE=<.006

TABLE 27

COMPARISON OF FEMALES AND MALES BY REASON FOR CHOOSING AN OCCUPATION

	REASON FOR CHOOSING AN OCCUPATION					
GENDER	INTRINSIC*	PEOPLE ORIENTED	SALARY	GLAMOUR	OTHER	ROW TOTAL
FEMALE	9	8	4	1	1	23
MALE	10	0	4	1	0	15
COLUMN TOTAL	19	8	8	2	1	38

CHI SQUARE=7.710

WITH 4 DEGREES OF FREEDOM

SIGNIFICANCE=<.10

*I.E. ENJOYS THE KINDS OF TASKS INHERENT TO EMPLOYMENT IN THIS OCCUPATION

TABLE 28

COMPARISON OF NON QUANTITATIVELY ORIENTED (NQO) STUDENTS AND QUANTITATIVELY ORIENTED (QO) STUDENTS BY EXTENT OF OLDER BROTHERS INFLUENCE ON POST HIGH SCHOOL PLANS

	EXTENT OF OLDER BROTHER'S INFLUENCE		
ORIENTATION	NOT IMPORTANT	IMPORTANT	ROW TOTAL
NQO	14	9	23
QO	18	2	20
COLUMN TOTAL	32	11	43

CORRECTED CHI SQUARE=3.361

WITH 1 DEGREE OF FREEDOM

SIGNIFICANCE=<.06

TABLE 29

COMPARISON OF FEMALES AND MALES BY THE EXTENT OF THEIR OLDER BROTHERS INFLUENCE ON THEIR POST HIGH SCHOOL PLANS

	EXTENT OF OLDER BROTHER'S INFLUENCE		
GENDER	NOT IMPORTANT	IMPORTANT	ROW TOTAL
FEMALE	12	2	14
MALE	2	7	9
COLUMN TOTAL	14	9	23

CORRECTED CHI SQUARE=6.797

WITH 1 DEGREE OF FREEDOM

SIGNIFICANCE=<.009

TABLE 30

COMPARISON OF QUANTITATIVELY ORIENTED FEMALES AND QUANTITATIVELY ORIENTED MALES BY THE EXTENT TO WHICH THEIR FATHERS INFLUENCED THEIR POST HIGH SCHOOL PLANS

	EXTENT OF FATHER'S INFLUENCE		
GENDER	NOT IMPORTANT	IMPORTANT	ROW TOTAL
FEMALE	1	11	12
MALE	5	4	9
COLUMN TOTAL	6	15	21

CORRECTED CHI SQUARE=3.543

WITH 1 DEGREE OF FREEDOM

SIGNIFICANCE=<.05

TABLE 31

COMPARISON OF NON QUANTITATIVELY ORIENTED (NQO) FEMALES WITH QUANTITATIVELY ORIENTED (QO) FEMALES BY THE EXTENT TO WHICH THEIR FATHERS INFLUENCED THEIR POST HIGH SCHOOL PLANS

	EXTENT OF FATHER'S INFLUENCE		
ORIENTATION	NOT IMPORTANT	IMPORTANT	ROW TOTAL
NQO	8	8	16
QO	1	11	12
COLUMN TOTAL	9	19	28

CORRECTED CHI SQUARE=3.714

WITH 1 DEGREE OF FREEDOM

SIGNIFICANCE=<.05

PSYCHOSOCIAL INFLUENCES ON
THE MATH ATTITUDES AND INTERESTS
OF BLACK JUNIOR HIGH SCHOOL STUDENTS

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PSYCHOSOCIAL INFLUENCES ON THE MATH ATTITUDES AND INTERESTS OF BLACK JUNIOR HIGH SCHOOL STUDENTS

Introduction

The current underrepresentation of Blacks, women, and other disadvantaged groups in American society in the areas of science and technology is well documented. The differential achievement among different race and sex groups on standardized tests is also a well-established and well-publicized fact. However, compilation of statistics and anecdotal evidence is an insufficient and oftentimes misleading approach to resolving these problems.

Furthermore, while many programs have been established by public and private organizations to address the current lack of Black, minority and female participation in the sciences and technical fields there is a two-fold problem with such efforts. One, such programs and efforts are based on current assumptions, stereotypes, beliefs, limited observations and experiences. A viable knowledge base does not exist at this point to guide the efforts of programs of this nature. Secondly, many of these programs are proceeding without evaluating in rigorous terms the results of their efforts. Thus, it will be difficult to ascertain if the appropriate questions and problems have been addressed and secondly if the programs are having some impact upon the problems that they are addressing. In short, more research is necessary in order to 1) go beyond the surface observation of differential performance on standardized tests and 2) to guide and assess the intervention actions of various public and private programs.

While different levels of achievement are reported for race and sex groups at levels ranging from the elementary school to the professional level, most efforts to date to address the imbalance in science and technical participation have been directed to the college and professional levels. The problem with this approach is that it only focuses on the problem in its later stages and does not examine the antecedents of the problem nor the development of it in its earlier phases and in contexts outside of the academic and professional worlds. Therefore, I would argue that more research is needed that examines the relationship among social, cultural and psychological variables which may influence Black math and science participation, especially during the formative years in a student's life. I would further maintain that a social systems model (Billingsley, 1968) of the interaction between the Black child, his family, community and the larger society may be helpful in examining the relationship among environmental, familial and personal factors, and in explaining the differential rates of achievement and participation of Blacks in scientific and technical endeavors.[1]

New approaches are needed not only in addressing these probelms programmatically, but also in the conceptualization and investigation of the root causes. In addition to looking at the factors limiting Black participation in the sciences and technical fields it is mandatory that those who are concerned about devising effective solutions, which are also culturally and socially compatible to the Black experience, be aware of enhancing factors that can contribute to increased Black involvement in these important areas of American life (see Johnson, 1978, 1979).

The Present Study

This article examines the relationship among certain psychosocial variables and the mathematics attitudes and activities of Black junior high school students. The students are seventh-and eighth-graders in an inner-city school system in the Midwest. The students in six classes at two predominately Black middle schools were involved in a quasi-experimental program to ascertain the effects of providing career information on science and technology in culturally sensitive ways on the science attitudes of the students. For purposes of this article attention is given solely to the relationship among math attitudinal and activity variables, the students' career aspirations, and parental occupation. It is assumed that these latter two variables reflect home and community influences.

Data on these variables were collected by means of a seven page questionnaire which was read to the students in their classrooms (generally in Social Studies or English classes). Many of the items are the same as or similiar to attitude questions used in the National Assessment of Educational Progress studies of science attitudes and performance (1975, 1978). Other items in this questionnaire were developed by the research staff on this project.

One hundred fifty-eight students participated in this study. All were Black with the exception of one female of Asian extraction. The students were between 12 and 16 years of age with the average (mean) age being 13.6 years. Most, seventy percent of the students were in the eighth grade and thirty percent in the seventh. The average age for the eighth graders was 13.9 (sd=.63), and that for the seventh graders were 12.9 (sd=.77). According to data on parental occupations most of the students come from low income or lower middle income families. Since no grade or sex differences were found on the various variables of interest,data are reported on this sample as a whole.

Level of Math Activities and Interests. Students reported low to medium levels of interest and involvement in activities related to mathematics. A composite index consisting of nine items asking about mathematics interest and activities was used to assess this variable. Forty-seven percent of the students responding to these items had low levels of involvement or interest in mathematics. Another forty-nine percent had medium-level and only three percent reported a high-level of interest or involvement in math-related activities. Furthermore, these items suggest that, for the most part, these students' involvement with math-related activities is limited to classroom or school situations.

The items making up this index and the students' responses to them are reported below in Table 1. These items were collasped to create a summary measure of math activities and interests. The categories "Never" and "Seldom" were combined and assigned a value of 1; "Often" was given a value of 2 and "Always" a value of 3. Those whose average response fell in the "never-seldom" range are classified as "low" in math activity and interest; those in the "often" range as "medium", and those in the "always" range as "high". The Cronbach's alpha, a coefficient of reliability measuring internal consistency of a scale is .816, quite acceptable for research purposes.

(Place table 1 here)

Social Importance of Mathematics. To assess the students' sense of the importance of mathematics in three different social contexts they were asked about the importance of mathematics in the advancement of society, in obtaining a good paying job, and its benefit to the Black community. These three items were used to create a singe index. Overall, the students felt that mathematics was socially important with 60% indicating that it was very important in these various contexts, 30% somewhat important and less than 2% indicating that it was unimportant.

An examination of the specific items shows that 35% of the students felt that math was important for societal advancement, 56% felt that it was somewhat important, 4% indicated that it was less important than any other subject, and 5% did not respond to this item. Almost 70% indicated that math was very important in getting a good paying job, about 25% felt that it was somewhat important in getting a good paying job, 1% felt that it was unimportant, and almost 5% did not respond to this question. When asked about employment, occupations, and professions which could benefit the Black community, 58% felt that it was very important for a person to have a good background in math, 31% felt that it was somewhat important, and 3% felt that it was unimportant to have a good background in math. About 8% did not respond to this item.

Generally, we see that students feel that mathematics play an important role in society, particularly in the area of jobs and the possible benefit that professional occupations requiring math backgrounds could render to the Black community. Students were more tentative in their assessment of the relative importance of mathematics for the advancement of society.

Students' Feelings About Math Teachers and Math Classes. Eighty-nine percent of the students reported that their teachers liked math. Seventy-two percent indicated that the teacher made math exciting and 62% felt that the teacher was enthusiastic about the subject. When asked how did they feel about their math classes, 33% felt that they were interesting, another 36% felt that they were challenging, 20% found them enjoyable, with less than 10% reporting that they were either boring, intimidating, or frustrating.

These data indicated the students feel positively about their math classes, regard their teachers in a favorable light, and show awareness of the importance of mathematics in society in general. However, by their own reporting they show a low level of interest or involvement in math activities. Also their math teachers evaluated almost 60% of the students as being either fair (38%) or poor (20%), while they rated 37% as either good (29%) or excellent (8%).

In an attempt to identify factors that may account for the low level of mathematics-related interests and activities, several variables at the level of the individual, the family and the larger society were examined.

The Math and Science Connection. The study of mathematics, while useful in its own right, is usually considered a requisite stepping stone to careers in the sciences and technological areas. Thus, data were also collected on students' interests in science, their views of science and technology in society, their career plans, and the occupations of their parents.

Science Attitudes and Interests. Several measures were developed from a series of released items from the National Assessment of Educational Progress' science attitude questions (1975). The one relevant to this discussion dealt with students' perception of themselves as scientists. That is, it attempted to measure personal identification with being a scientist (for example, items such as: "I would like to become a scientist", or "For me to become a scientist would be harmful or beneficial" or "Studying science in school is hard or easy"). The reliability coefficient of this scale, as measured by Cronbach's alpha, is .789.

On this composite index less than 20% of the students had responses that showed a high regard for themselves as a scientist or identification with the process of becoming a scientist. For example, only 6% agreed with one of the items of this index "I would like to become a scientist". The vast majority of the students in this sample (75%) demonstrated only some interest in becoming a scientist.

The student's perception of himself as a scientist is considered important for a number of reasons. First, in order for a person to engage in a scientific career that person must have the perception or awareness that he or she is capable of becoming a professional in this area. Related to this notion is the relationship of self-concept to academic achievement (and subsequent professional accomplishment). While it was earlier thought that Black students had negative self-concepts and that poor academic performance could be accounted for in part by these, more recent research has shown that Black children as a rule, have high senses of personal worth transmitted to them by their families (Cross, 1978). These recent findings, therefore, suggest that global indicators of self-concept do not provide the necessary information about Black children. However, this measure of self as scientist is more specific to the task at hand. Namely, it focuses specifically on the student's feelings about personal involvement in the scientific process, and therefore should be more useful in assessing student attitudes toward scientific careers.

As noted earlier the relationship between mathematics and science is evident. Therefore, this measure of perception of self as scientist is useful to explore interest, attitudes and performance in mathematics.

Factors Related to Mathematics Activities and Interests. A highly significant relationship was found between the measure of self as scientist and students' report of their levels of mathematical activities and interests. Those with high perceptions of self as scientist were also more likely to report high levels of math activities and interests. Fifteen percent of those scoring high on this measure reported high levels of math activity compared with 28% for those scoring in the medium level and 0% for those scoring low on this measure. Table 2 presents these data.

(Place Table 2 here)

Interestingly, students who report a high perception of self as scientist are generally not the students who are rated by their math teachers nor science teachers as being the best students in these subjects (see Table 3 and 4). Of the 58 students rated as being good or excellent students in math only 22% have high scores. Likewise, of the 50 students rated by the science teachers as being excellent or good in this subject, less than 25% are among those who had high scores on this measure. These data can lead to one of several conclusions. First, good students in math and science are unaware of their scientific potential and do not rate themselves highly on this factor. Secondly, it may be that there are students in the math and science classrooms who have the interest in these areas but whose potential are not being tapped by either the classroom situation or the teachers. Or, both of these reasons may be plausible. Data from this study do not allow one to determine which of these possibilities is the more likely one, although I am inclined to favor the latter one.

On the other hand, students who had high ratings on the self as scientist scale tend to evaluate their math teachers favorably (see Table 5). This would suggest that although some of these students are not doing well in mathematics (and in science) there is the potential for them to improve their performance since they have positive feelings about their teachers, and, therefore, by inference, good rapport with them.

(Place Table 3,4,5 here)

No association was found between the students' reported level of interest in math and science activities and the teachers' evaluation of the students in math and science. Of those who reported a high level of math-related activities 80% were rated fair by their math teachers and 20% as good. This is to say that only one of these students was among the 58 students who were rated as good or excellent by the math teachers. Forty-five percent of those rated by the teachers as being good or excellent students in mathematics were found in the middle level of math interest and activity. Fifty-three percent of these students were in the lower level of math activity. This same situation held true for the science teachers' evaluation of the students. Only 2 of the 5 students who had high scores on the math activities scale were rated as good students by their science teachers. The other three had fair ratings. Forty percent of the good and excellent students were in the middle level on the math activities scale and 56% were on the low level of the math activities scale.

There was no correlation between students' reported levels of math-related activities and their evaluations of their math teachers. On the other hand, there was a highly significant relationship between the students' evaluation of the teachers and the teachers' evaluation of the students' math performance. Generally, the higher the teachers' rating of the student the higher the students' rating of the teacher. (Table 6 presents these data). From these findings it is plausible to assume that teachers' expectations and attitudes are important variables affecting both the performance as well as the activities of students. However, the data on this sample of junior high school students do not permit an examination of the precise role and function of teachers in the development of mathematical and scientific-related interests and activities. (This relationship is being assessed as part of a larger study in progess by the author).

(Place Table 6 here)

The measure of the level of math activity and interests also showed positive and significant correlations with a number of other attitudinal variables. These are the perception of the role of mathematics in society (X^2=13.74, df=4, p=0.009), the level of students' interest in science (X^2=30.15, df=4, p=0.000), the students' feelings about math classes (X^2=10.55, df=2, p=0.005), and the importance of a math background in the development of the Black community (X^2=10.36, df=4,p=0.004).

Students' Career Aspirations and Math Interests. Overall, students were unlikely to select scientific, technical, or medical careers (14.6%) or other professional occupations (15.9%). On the other hand students were more likely to select white-collar, blue-collar, skilled labor, crafts or unskilled labor occupations as their career choices (21.7%). Also a sizeable number of students (17.2%) selected entertainment, athletic, or arts professions as career choices. The largest number of students however (30.6%) either identified several career choices, career interests not listed above or were undecided.

Of the 5 students reporting high level of math activity and interest, only one indicated an interest in a scientific or technical career. The other four students expressed career interests that were either in several categories or were unspecified. Students reporting low or medium levels of mathematics activities and interests were fairly equally distributed among the various career choices and occupational categories. Table 7 contains the data on this relationship.

(Place Table 7 here)

No relationship was found between the career interests of the students and parental occupation. Most of the students' parents were employed in the lower occupational categories or were unemployed. Many of the students did not know their father's occupation (25.3%); and 11.4% did not know their mother's occupation. The data on the parental occupation are presented in the table below (Table 8).

(Place Table 8 here)

Whereas there was no relationship between the math interests of the students and their career choices, significant relationships are found between teachers' assessment of the students' math and science performance and students' career choices. As the data in Table 9 indicate, students who are rated "excellent" in mathematics show no interest in scientific, technical or medical careers. On the other hand they are likely to show interest in other professional occupations and in the areas of sports, entertainment or the arts, or to have vague or no notion of their career choices. Students identified as being "good" in mathematics were more likely to select technical, scientific or medical careers as a choice than most of the other categories of career options and were more likely than those in the fair or poor categories. However, the largest percentage of students in the good category fell in the other, don't know or several choices category (46.7%). Those students who were rated "fair" or "poor" were more likely to select occupations in the lower occupational categories than were the other students. However, it is interesting to note that students in these categories were more likely to select scientific-technical professions than were students rated as excellent. On the other hand, students rated as excellent were more likely to select sports, entertainment or arts professions than the fair or poor students. These data clearly show that students with the ability for mathematics are misguided or unguided in their career options.

(Place Table 9 here)

Students rated as excellent by their science teachers were for the most part unclear about their career options (45.6%) or else chose other professional occupations as their career interests (36.4%). The same number chose scientific and technical careers (9.1%) as those who chose entertainment, sports and the arts as career options. Students rated as good are also more likely to be vague about their career choices (41%). However, a larger percentage of these students have identified scientific-technical fields as a career choice. A sizeable portion (15.4%) have chosen athletics, entertainment or arts professions. Students who are rated poor or fair in science by their teachers are less likely to choose scientific or technical professions than are the other students and are more likely to choose the lower level occupations. (See Table 10).

(Place Table 10 here)

Data from these analyses show that students including the good ones, are not attracted to or are aware of scientific, technical and medical professions as a career option in the early stages of their academic careers. It is also interesting to note that those students who are highly evaluated by their math and science teachers do not choose lower-level occupations as their career options. However, they are overrepresented among those students choosing several types of occupations, or having vague notions of what they want to do.

Conclusions

Students show positive attitudes toward math classes and teachers, although they have low levels of math-related interests and activities. They recognize the importance of math and science in different social contexts. However, in addition to having little math-related activities and interests, most of the students in this sample are rated by their teachers as low to average achievers in mathematics and science. However, teachers' ratings do not correlate significantly with students' reports of their math and science activities and interests.

These differences show up in students' career selections. Those who identify themselves as being interested in math and science activities are more likely to identify math-and science-related careers as their preference. On the other hand, those who are identified by teachers as being good or excellent students are more likely to be uncertain about their career plans or do not select scientific or technical careers. Those who are self-identified are less likely to select sports, entertainment and related fields as their career options, whereas many of the students rated as excellent in science and math by their teachers are likely to do so. However, regardless of which measure is used, a number of students with potential, whether self-identified or teacher-identified, do not have clear career options in mind, especially concerning scientific, medical and technical fields.

While parental occupation did not have any association with the math interests of the students in this sample or with their career choices, it cannot be ruled out as a factor since many students have preferences similar to their parents' occupations. Also, sufficient numbers of students from higher socioeconomic backgrounds were not in the sample to make valid comparisons across family socioeconomic status.

While demonstrating ability in math, positive attitudes toward math classes and math teachers, and indicating a general recognition of the importance of math in society, students are not prone to consider math-related fields or career options. These students are generally either vague about their career aspirations, likely to select non-professional (both white-collar and blue-collar) occupations, or are interested in "glamour" careers (sports, entertainment). These findings suggest that a great deal of potential awaits to be tapped among this segment of the population. However, it is also clear there is a lack of pertinent information and guidance to students about career possibilities in the scientific, technical, and medical fields at this early level.

Students' career choices reflect what they see around them in the homes (i.e. parental occupations) or the images broadcast to them from the larger society, generally from the media and the community (hence the selection of sports, entertainment, etc. as career options). This "image problem" may account for the large number of students with high teachers' ratings not indicating an interest in science and mathematics, and who do not regard themselves as potential scientific, technical or medical persons. On the other hand, there are students with such interests and perceptions but these interests apparently aren't being identified, tapped, or channeled by the schools.

It is clear from these observations that there is need for more direct intervention programs at the lower-school levels and in the homes and communities of these students in order to direct their interests and abilities toward scientific and technical fields. However, as noted above, it is mandatory that a scientific basis for initiating and evaluating such programs be established, and that such programs interlink with current efforts at the collegiate and professional levels to increase Black participation in math-based professions. The Bad Bishops of Philadelphia are a good example of how low-income Black youths can have their interests and potential channeled into productive use by a challenging program. These youngsters are the premier chess players in the country in their age group, having gotten their start in their junior high school math classes (Helyar, 1981). However, this potential is not further channeled or challenged beyond this level, and many of these great young minds are swayed by other influences and interests.

With current efforts to redress the paucity of Black scientists and technologists focusing primarily on collegiate and professsional populations, only a very narrow segment of the talent is being reached. Programs are needed that go farther back into the "pipeline" to the home environment and to the lower-school levels. Furthermore, special efforts must be made to harness and develop the potential of low-income students, since they constitute a sizeable portion of Black youths. For if any increase is to occur and this group is not to be permanently assigned to the Black underclass in a technological society, it has to be tapped for its scientific and technical potential.

Notes

1. Rever (1973) has similarly advocated a methodological approach which combines environmental and personal variables in the study of scientific and technical career selection.

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Table 1

MATH ACTIVITY AND INTEREST ITEMS
(Response in Percentages)

ITEM	ALWAYS	OFTEN	SELDOM	NEVER	NOT REPORTED
How often do you...?					
Read articles about math in magazines	5.1	16.5	49.4	25.9	3.2
Read articles about math in newspapers	4.4	9.5	25.3	57.6	3.2
Watch T.V. shows which focus on math	13.9	20.9	44.3	17.7	3.2
Go to math lectures	8.2	15.2	19.6	51.3	5.7
Read books on math	27.8	31.6	25.9	10.1	4.7
Do math projects which are not required in math classes	9.5	27.2	32.9	27.2	3.2
Have hobbies which are related to math	13.3	21.5	33.5	28.5	3.2
Solve math problems	33.5	38.6	17.7	6.3	3.8
Talk to friends about math	17.7	45.6	27.8	4.4	4.5

Table 2

STUDENTS' PERCEPTION OF SELF AS SCIENTIST BY LEVEL OF MATH ACTIVITY/INTEREST

	LEVEL OF MATH ACTIVITY/INTEREST			
PERCEPTION	LOW	MEDIUM	HIGH	ROW TOTALS
Low	57.1% (4)	42.9% (3)	0% (0)	100% (7)
Medium	47.9% (57)	51.3% (61)	0.8% (1)	100% (119)
High	40.7% (11)	44.4% (12)	14.8% (4)	100% (27)

Number of observations = 153

(X^2=14.06, df=4, p=0.0071)

Table 3

STUDENTS' PERCEPTION OF SELF AS SCIENTIST BY MATH TEACHERS' EVALUATION OF STUDENTS' MATH PERFORMANCE

	MATH TEACHERS' EVALUATION				
PERCEPTION	POOR	FAIR	GOOD	EXCELLENT	ROW TOTALS
Low	42.9% (3)	14.3% (1)	28.6% (2)	14.3% (1)	100% (7)
Medium	21.6% (25)	42.2% (49)	25.9% (30)	10.3% (12)	100% (116)
High	14.8% (4)	37.0% (10)	48.1% (13)	0% (0)	100% (27)

Number of observations = 150

(X^2=10.03, df=6, N.S. at .05 level)

Table 4

STUDENTS' PERCEPTION OF SELF AS SCIENTIST BY SCIENCE TEACHERS' EVALUATION OF STUDENTS' SCIENCE PERFORMANCE

	SCIENCE TEACHERS' EVALUATION				
PERCEPTION	POOR	FAIR	GOOD	EXCELLENT	ROW TOTALS
Low	42.9% (3)	28.6% (2)	14.3% (1)	14.3% (1)	100% (7)
Medium	29.8% (34)	38.6% (44)	25.4% (29)	6.1% (7)	100% (114)
High	29.6% (8)	25.9% (7)	33.3% (9)	11.1% (3)	100% (27)
Number of observations =					148

(X^2=3.57, df=6, N.S. at .05 level)

Table 5

STUDENTS' PERCEPTION OF SELF AS SCIENTIST BY STUDENTS' EVALUATION OF MATH TEACHER

	EVALUATION OF MATH TEACHER			
PERCEPTION	POOR	FAIR	GOOD	ROW TOTALS
Low	14.3% (1)	57.1% (4)	28.6% (2)	100% (7)
Medium	0.8% (1)	45.4% (54)	53.8% (64)	100% (119)
High	0% (0)	30.8% (8)	69.2% (18)	100% (26)

Number of observations = 152

($X^2=12.73$, $df=4$, $p=0.013$)

Table 6

STUDENTS' EVALUATION OF MATH TEACHER BY TEACHER'S EVALUATION OF STUDENTS

	TEACHER EVALUATION				
STUDENT EVALUATION	POOR	FAIR	GOOD	EXCELLENT	ROW TOTALS
Poor	100% (2)	0% (0)	0% (0)	0% (0)	100% (2)
Fair	31.7% (20)	42.9% (27)	20.6% (13)	4.8% (3)	100% (63)
Good	11.9% (10)	39.3% (33)	36.9% (31)	11.9% (10)	100% (84)

Number of observations = 149

(X^2=19.46, df=6, p=0.004)

Table 7

LEVEL OF MATH ACTIVITY/INTEREST BY CAREER CHOICE

	CAREER CHOICE					
MATH ACTIVITY	SCIENTIFIC, TECHNICAL, MEDICAL	OTHER PROFESSION	SPORTS, ENTERTAINMENT, ARTS	CLERICAL, SALES, SERVICE, MILITARY	SEVERAL, VAGUE, UNDECIDED	ROW TOTALS
Low	9.7% (7)	15.3% (11)	19.4% (14)	22.2% (16)	33.3% (24)	100% (72)
Medium	17.3% (13)	18.7% (14)	14.7% (11)	24% (18)	25.3% (19)	100% (75)
High	20.0% (1)	0% (0)	0% (0)	0% (0)	80.0% (4)	100% (5)

Number of observations = 152

(X^2=10.15, df=8, p=0.26)

Table 9

MATH TEACHERS' EVALUATION OF STUDENTS BY STUDENTS' CAREER SELECTIONS

	CAREER SELECTION					
TEACHERS' EVALUATION	SCIENTIFIC, TECHNICAL, MEDICAL PROFESSION	OTHER PROFESSION	SPORTS, ENTERTAINMENT. ARTS	CLERICAL, SALES, SERVICE, MILITARY	SEVERAL, VAGUE, UNDECIDED	ROW TOTALS
Poor	6.3% (2)	15.6% (5)	21.9% (7)	43.8% (14)	12.5% (4)	100% (32)
Fair	15.3% (9)	16.9% (10)	15.3% (9)	22.0% (13)	30.5% (18)	100% (59)
Good	20.0% (9)	13.3% (6)	11.1% (5)	8.9% (4)	46.7% (21)	100% (45)
Excellent	0% (0)	30.8% (4)	30.8% (4)	7.7% (1)	30.8% (4)	100% (13)

Number of observations = 149

(X^2=28.22, df=12, p=.005)

Table 10

SCIENCE TEACHERS' EVALUATION OF STUDENTS BY STUDENTS' CAREER SELECTIONS

	CAREER SELECTION					
SCIENCE TEACHERS' EVALUATION	SCIENTIFIC, TECHNICAL, MEDICAL PROFESSION	OTHER PROFESSION	SPORTS, ENTERTAINMENT, ARTS	CLERICAL, SALES, SERVICE, MILITARY	SEVERAL, VAGUE, UNDECIDED	ROW TOTALS
Poor	6.7% (3)	15.6% (7)	22.2% (10)	42.2% (19)	13.3% (6)	100% (45)
Fair	7.7% (4)	19.2% (10)	15.4% (8)	19.2% (10)	38.5% (20)	100% (52)
Good	25.6% (10)	10.3% (4)	15.4% (6)	7.7% (3)	41.0% (16)	
Excellent	9.1% (1)	36.0% (4)	9.1% (1)	0% (0)	45.5% (5)	100% (11)

Number of observations = 147

(X^2=34.72, df=12, p=0.0005)

A PARTIAL BIBLIOGRAPHY ON BLACKS
IN
SCIENCE, TECHNOLOGY, AND RELATED AREAS

Compiled by The Black Mathematical
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INTRODUCTION

This bibliography has grown out of the efforts and activities of the staff of the Black Mathematical Orientation Project to identify and collect materials and information related to Black participation in scientific, technical and math-based fields and endeavors. Additionally, materials and bibliographies developed by other writers and scholars have been incorporated in this work. Mr. Robert Hayden and Dr. John Henrik Clarke[1] graciously granted permission to incorporate their listings into this bibliography, further enriching its content and value.

The areas included in this bibliography are "Energy and Engineering," "Inventors and Scholars," "Mathematics," "Medicine," and"Science and Technology". These categories were formed on the bas of the materials and references at hand; they are not complete, exhaustive, nor mutually exclusive. The pie could have been sliced differently.

The Black Mathematical Orientation Project is a National Institute of Education funded research project designed to identify psycho-social factors that may affect mathematics learning and utilization among Black Americans. Staff members who contributed to the compilation of this document by their diligent work are: Ms. Donna Blackwell-Taylor, Project Director; Ms. Rhonda Benjamin, research assistant; and Ms. Marcia Tate, project secretary.

We request that users of this bibliography send us any references or materials which can be added to this incomplete and unsystematic listing. Some materials were received after the bibliography had been prepared for printing and could not be incorporated. However, a vast amount of information and references on Blacks in the various areas of science and technology remains to be systematically collected and catelogued; and that type of effort represents in and of itself a major undertaking. Any suggestions for improving this nascent attempt would be greatly appreciated and extremely helpful. Please send remarks and/or materials to:

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